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CONTENTS

	PAGE
Interpretation and Exposition of Scientific Research	429
Science in Industry	432
Relics of the Mt. Pelé Eruption of May 8, 1902. By Dr. C. T. Trechmann	435
An Historic Mantelpiece at the Royal Institution. By Thomas Martin	437
Obituary Notice:	
Dr. C. Lallemand. By H. St. J. L. W.	439
News and Views	440
Letters to the Editor:	
Glycogen Breakdown in Muscle Extract and Yeast Juice.—H. Lehmann	470
Magnesium and Calcium Content of Hedgehog Serum during Hibernation.—Dr. Paavo Suomalainen	471
A Contradiction in the Present Clearance-Reabsorption Views of Urea Excretion.—Prof. E. J. Conway	471
Decomposition of Organic Peroxides.—E. J. Harris and Prof. A. C. Egerton, F.R.S.	472
Meteoric Ionization in the *E* Region of the Ionosphere.—Prof. A. M. Skellett	472
Disintegration Processes by Cosmic Rays in Plates impregnated with Samarium.—Prof. H. J. Taylor, D. Fraser and V. D. Dabholkar	472
Factors influencing Stability of Superlattices.—Ralph Hultgren and Lester Tarnopol	473
Some Observations on the Rotating Pendulum.—Dr. R. J. Lythgoe	474
Metallography: a New Technique.—Bruce Chalmers and W. E. Hoare	475
The Kurumi (Japan) Meteorite.—Fletcher Watson, Jr.	475
The Australian Aborigines.—Sir James Barrett, K.B.E., C.B., C.M.G.	476
Research Items	477
The Soviet Polar Enterprise. By R. N. R. B.	480
Veterinary Science in India.	480
The New Super-Novæ	481
Development of Co-axial Cables for Television	482
Fuel Research in Great Britain. By H. J. H.	483
Science News a Century Ago	484
Societies and Academies	484
SUPPLEMENT:	
Pascal and Seventeenth-Century Physics. By A. F.	445
Is the Universe Expanding? By Prof. W. M. Smart	446
Studies in Human Behaviour	448
A Jungle Tribe of Malaya	449
Culture-Contact in India. By J. H. H.	450
Hunting by Scent. By J. H. K.	451
Plant Physiology for Students	451
South African Earthworms. By W. T. C.	452
A New Continent. By J. N. L. B.	453
Industrial Catalysis	454
Primes and Factors. By Prof. L. M. Milne-Thomson	454
Developments in Theories of Integration. By A. v. Z.	455
Short Notices	456
Forthcoming Books of Science	466

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Interpretation and Exposition of Scientific Research

ONE of the most important tasks of the Department of Scientific and Industrial Research, in the view of the Advisory Council, as indicated in the report of the Department for 1936-37, a summary account of which appears on p. 432, is to organize the conduct of research so as to promote contact with industry. Particular attention is given to this question of contact with industry in a number of the recent reports of the Advisory Council, and one reason for attaching importance to the development of the research association movement is the opportunity it affords for the industrialist to state his problems to the man of science and to determine the order of priority, in terms of their economic importance, of the objectives of particular proposals for research.

The success of the Department in fostering co-operation with an even wider range of industries and interests than is represented by the research associations is well illustrated by the work of the Water Pollution Research Board, the first ten years' work of which is reviewed in some detail in the latest report of the Advisory Council. In spite, however, of all that the Department has done to promote the application of results by industry, British industry still appears to lag behind industry in the United States.

Special attention is directed to this point by the Advisory Council in commenting upon a visit paid last year to Great Britain by a party of some thirty American business men and bankers who came to take stock of the conditions under which research is carried out here, and of the organization adopted to promote the practical application of its results. The visit was organized by the Division of Engineering and Industrial Research of the National Research Council of America, and after spending a fortnight in England the visitors proceeded to France and then to Germany, where they made similar inquiries. In Great Britain, the arrangements for visiting laboratories were made in close co-operation with the Department of Scientific and Industrial Research. The strenuous programme included visits to the Science Museum, the National Physical Laboratory, the Fuel Research Station, the Building Research, the laboratories of four research associations and of five representative industrial corporations as well as to the Cavendish Laboratory, Cambridge.

The tour was arranged primarily for the information of business men and bankers whose chief interest in the laboratories they visited was the utilitarian requirements of commerce and finance. The tour provided a striking object lesson in the keenness of industrial management in the United States to ensure that no opportunity is lost of turning science to the advantage of its business, and in commenting on the tour the Advisory Council refers to the necessity in Great Britain of giving more attention to the presentation of the progress of industrial research to what are described in the United States as the executives of business. What is here required is the presentation, not so much of scientific data, as of their industrial and financial implications, and in reviewing the various aspects of the publication policy pursued by the Department, the Advisory Council raises again the question of the interpretation of the results of scientific research which has an ever-growing importance.

A first objective in the publication policy of the

Department is, of course, the provision of the full scientific data of the researches carried out so that the technical man can judge of their value for himself and apply them in his own industry. To a large extent, this need is already admirably served by special reports published on behalf of the Department by H.M. Stationery Office, as well as by papers read before the learned and technical societies and by special articles contributed to technical and trade journals. Indeed, many of the reports and papers emanating from the Department set an admirable example of lucidity of exposition which could be followed with advantage by other scientific workers in presenting the results of their work.

Increasing attention is being paid by the technical Press to the activities of the Department, and this not only in itself promotes the dissemination of the reports themselves but also provides one means of presenting the work to the executive leaders of industry. There can be no doubt that in the last few years the interest of the general Press in scientific news has greatly increased, and already in the United States of America Science Service has been developed to render expert assistance to the Press in this field and particularly to overcome some of the difficulties encountered in presenting scientific news in a form which can be understood by the public.

Industrial research has its own special difficulties in this matter. The germ of an industrial advance is usually found in a discovery in the laboratory, but its development and final applications to industry may take a long time. Great caution is accordingly always necessary in the presentation of the initial discoveries before their industrial applications have been explored and tested. Apart from the hampering effect of premature disclosure on technical development, which is often much less serious than is supposed, unfulfilled prophecies are themselves liable to be detrimental to the general application of research. On the other hand, when the necessary reserve and caution are used in announcing the early stages of some new work the result often makes dull reading whether to the business executive or to the man in the street.

For these reasons, the Advisory Council attaches more importance to the fact that the Press is doing its utmost to stress the value of research in national development. It should be obvious, however, that the tasks of presenting results to business executives and also to the ordinary tax-payer, who provides the major part of the Department's expenditure and has every right to be told how the results are of benefit to him and to the nation as a whole, are by no means identical. For both purposes, the results must be expressed in non-technical language, but the content and emphasis required in the exposition are very different.

We have here a problem to which scientific workers, whether in industry or not, might well give more attention. Nor is it a problem for them alone. Fundamentally, it is one of co-operation between the technical or scientific worker and the Press, only to be solved as mutual understanding and respect are established. Although the Press in Great Britain has not moved anything like so far in the utilization of scientific men for the collection and editing of news as in the United States, and generally gives less care and thought to the presentation and accuracy of scientific news than to most other specialized activities, generally speaking it is much more alive than formerly alike to the significance and importance of scientific work and to the difficulties in the way of its accurate exposition or interpretation. In fact the first need to-day is probably for a greater response and willingness to co-operate on the part of the scientific worker himself.

Much is indeed involved in such co-operation. In the first place, there is still far too much jargon and loose expression in scientific or technical papers. It is true, of course, that the scientific investigator is entitled to use the same vocabulary as other workers in the same field when addressing himself to a scientific society, but unfortunately insufficient care is often taken in regard to the introduction of new terms even here. Moreover, many scientific workers are guilty of confused thinking and want of care in arranging their ideas in logical sequence or in expressing them concisely.

Such careless writing places difficulties in the way of the appraisement or evaluation of the work of the scientific investigator by his own colleagues and still more in its interpretation to the non-technical man or general public. The scientific worker has to remember that his work has not fully achieved its purpose until it is understood and can be integrated into the general body of knowledge of the science or industry.

This in turn demands from the scientific worker not only a much greater respect for accurate and lucid writing, and more whole-hearted attempts to see that the careless use of words does not invalidate accurate and painstaking experimental

work but also an appreciation of the position and work of the expositor and in particular of the work which the Press is trying to do. High ability in research and felicity of exposition are by no means always linked in the same person, and investigator and expositor have each their place to fill and merit their own reward. The lack of regard of scientific men for some of the ablest expositors in their own ranks is probably one reason why science is not so widely and well served in that respect as is desirable.

If most scientific workers have little desire or capacity to transform the special vocabularies of their subjects into the simpler and not necessarily sensational forms required by the general reader, remembering these things, they should be more grateful for the service rendered to science itself by those who are able to present a scientific subject accurately and attractively in a literary style.

Fundamentally, therefore, this question of publication turns on education, both that of the man of science in the capacity to express himself in terse and lucid English, and that of the general member of the public, whether of the Press or not, so that he has a general scientific background against which to set scientific or technical progress as it is made known. Both aspects are of importance, but it would be a mistake to imagine that the printed word is the only means by which the results of scientific work can be brought before the community.

One such method is seen in exhibitions organized by the Department of Scientific and Industrial Research to show the results of its research. Already a number of such exhibits has been arranged: at the Smoke Abatement Exhibition in the Science Museum, at the Public Health Exhibition in the Royal Agricultural Hall, at the Engineering Exhibition in Greyfriars Hall, Cardiff, at the Building Centre and at the Exhibition of Testing Plant and Apparatus at the Institution of Civil Engineers and at the Engineering and Marine Exhibition. The Advisory Council considers that this activity provides an excellent means of forming contacts between the staff of the Department and those engaged in industry, and assists in making better known the facilities available in the Department for co-operative research and for dealing with special inquiries.

The method is of course already in use by many industrial firms both in connexion with their technical service work and to make known the results and scope of their research, as in that recently organized by Imperial Chemical Industries Ltd., in connexion with the opening of the new research laboratories at Blackley, Manchester. Other examples are to be found in the special exhibits arranged at the Science Museum and elsewhere, and the success they have achieved indicates that exhibits of this type offer a very valuable means of bringing the results of scientific and industrial research before the general community.

In connexion with the preparation for exhibits, the Department of Scientific and Industrial Research has recently begun to make short films dealing with the work. These films have already proved of great value in illustrating lectures given all over the country by officers of the Department and they are in some demand by technical societies. Here again is a medium of education and exposition to which scientific workers might well give more attention, while the series of talks which from time to time have been broadcast under such titles as "What more do you want of the scientist?" or Dr. Julian Huxley's talks on scientific research and social needs indicate yet another medium which science itself has placed at their disposal.

The reference to these matters in the Advisory Council's report is the more welcome because the lack of unity in the profession of science makes it difficult to utilize the opportunities of interpretation and exposition which are in these ways offered to the world of science. The Department indeed is probably in almost a unique position in its capacity and ability to interpret to the world of industry and to the community generally the results of both pure and applied scientific research. Already its publications indicate an attention to the art of exposition and interpretation which are seldom elsewhere paralleled in the scientific world, except in the technical publications issued by the publicity departments of a number of our more progressive industrial firms—publications themselves insufficiently appreciated by scientific workers. With a little more support and co-operation from scientific workers generally it should not be impossible for the Department to explore even more widely the possibilities not only of publications but also of such other media as exhibitions, the film or the broadcast talk in interpreting to the ordinary citizen the significance and meaning of the achievements of scientific and technical research. At least it may be hoped that the latest report of the Advisory Council will again direct the attention of scientific workers to a question which has far too often been neglected or disdained.

Science in Industry

THE twenty-second report of the Department of Scientific and Industrial Research*, which covers the period October 1, 1936–September 30, 1937, includes the report of the Committee of the Privy Council signed by Lord Halifax, and the longer report of the Advisory Council signed by Lord Riverdale, together with a summary of the work of the National Physical Laboratory and other research stations and research boards and brief reports from the various research associations. Both the report of the Advisory Council and of the Committee of the Privy Council pay tribute to the work of Lord Rutherford, whose last act as chairman of the Advisory Council was to shape the report which is now submitted. The present report once more displays the impressive contribution which the work of the Department makes to every aspect of our national life.

The expenditure of the Department in 1936-37 was £830,180 gross or £583,230 net as against £571,831 net in 1935–36. The largest single item of expenditure was £105,589 on the National Physical Laboratory, compared with £109,038 in 1935–36, the gross expenditure of £244,081 covering, however, the cost of work carried out at the laboratories of the Food Investigation Board, the Radio Research Board, the Road Research Board and other research boards of the Department. Against this gross total, receipts amounted to £138,492, of which £67,863 represents fees from industry for paid work. The total receipts from industry for the work of the Department, including contributions to co-operative research, amounted to £106,250, while a further £77,101 was received from other Government Departments for services rendered, £35,035 from the Road Fund and £9,543 from the Empire overseas for food investigation. Expenditure on fuel research was £105,660 gross or £92,809 net, on building and road research £87,957 gross or £32,264 net, on the Chemical Research Laboratory £21,146 net, on forest products research £39,382 net and on the Geological Survey and Museum £68,449. Almost the whole of the expenditure of £10,613 on water pollution research was covered by receipts amounting to £9,215, while £15,928 was received against the gross expenditure of £54,926 on food investigation. Grants to research associations, etc., amounted to £126,510 as against £108,951 in 1935–36 and £85,384 in 1934–35, and the report notes the formation of a new Research Association by the Pottery Manufacturers' Federation, to which the Department has made an annual grant of £5,000.

Special stress is laid in the report of the Advisory Council on the work of the Water Pollution Research Board, which has now completed ten years work and in that time has succeeded to a remarkable extent in bringing about a realization of the community of interest in all concerned and in establishing scientific research as the true servant of all parties. The intensive survey of the River Tees and of the effects of the discharge into it of large quantities of sewage and of industrial effluents has led to the discovery that the true cause of the killing of smelts in the estuary is cyanide in coke-oven effluent. Further, it has been found that this cyanide can be readily converted into the much less toxic ferrocyanide if it is treated with spent pickle liquor and lime. At the same time, the suggestion has been put forward that modified methods for cooling and washing coke-oven gas and the use of any remaining waste waters to quench coke would greatly reduce the quantity of the discharge. This suggestion has already been followed in a large installation of coke ovens recently erected at South Bank on the Tees.

This notable survey, with its demonstration of the possibility of reconciling the community's requirements in regard to pure water supply and the industrial disposal of effluent, has already led to a further investigation of the effect of crude sewage discharge on the navigability of the Mersey, which has just been completed. Successful work has also been carried out on the treatment of effluent from beet-sugar factories and from large dairies, while at the Chemical Research Laboratory the Board has sponsored studies of the softening of water, in which certain synthetic resins have given promising results.

This review of the work on water pollution well illustrates the cumulative effect of such investigations as a body of knowledge is built up which can be readily applied to the solution of allied problems as they arise, and the recent typhoid epidemics at Croydon and elsewhere emphasizes the importance of constant scientific control if a pure water supply is to be secured. So, too, in the field of atmospheric pollution the Department is steadily acquiring scientific data on the extent and distribution of pollution and is making a special survey of the city of Leicester which should ultimately provide the basis for effective action to

* Department of Scientific and Industrial Research. Report for the Year 1936–37. (Cmd. 5647.) Pp. iv+195. (London: H.M. Stationery Office, 1938.) 3s. net.

diminish the toll at present taken of health and general welfare in industrial centres by this cause.

Passing from water supply and air to food supply, we find the Department making equally significant contributions. The researches of the Food Investigation Board have ranged, for example, from the study of storage problems such as the value of ultra-violet light in prolonging the storage-life of meat, the effect of the concentration of carbon dioxide in the atmosphere in which eggs are stored, the diminution of 'store-burn' in the storage of poultry, the cold storage of herrings, the gas-storage of pears, strawberries and other fruits, to the chemical composition of wood smoke used in curing fish, the effect of muscular exertion on the chemical composition of muscular tissue and the keeping quality of bacon. Further trials have confirmed that freshly caught white fish can be brine frozen, glazed and stored so that after four to six months the fish is highly palatable, suitable for smoke curing and substantially unchanged. Of special interest are the results obtained from a further scientific expedition to Australia and New Zealand to study the performance of the new 'jacket' system of refrigeration developed at the Ditton Laboratory of the Department. The full data obtained are still being examined, but the new system appears to be working satisfactorily. In the great bulk of a stack of 50,000 cases of apples the temperature was uniform within 0·5° F., and with the new system about 3,000 more cases could be carried than with normal storage.

The bearing of these results on food supply and particularly in view of the increased importance of storage questions should be obvious to all whether in relation to national defence or to the questions of quality or public health. Equally important work is, however, being carried out in this field by a number of research associations. The Research Association of British Flour Millers has succeeded in developing a machine for measuring and recording graphically the baking quality of flours and a full-scale plant has now been erected for improving the baking quality of flour and the crumb quality of the bread by treatment with hot damp air according to the process developed in 1928. Other investigations of the Association have related to the nutritive value of bread and the place of bread in the dietary. The Research Association for the Cocoa, Chocolate, Sugar Confectionery and Jam Trades has investigated the resistance of cacao butter to oxidation changes with the view of avoiding the stale flavours associated with such changes, as well as the mechanism of pectin jelly formation by fruits, and is making a special study of toffee manufacture as well as of the protection of cacao beans, nuts, dried fruits, etc., against storage pests. The Food Manufacturers Research Association has been responsible for investigations on the curing of bacon by a new method, the quality of gelatin used for meat products in glass cases, and the cause of white deposits on fish preserved raw by packing in salt.

Turning from food supply to fuel and lighting we find an equally impressive record of service rendered to daily needs. Besides the physical and chemical survey of the national coal resources and the study of the hydrogenation of coal with its bearing on the more effective utilization of coal whether primarily as fuel, as motor spirit or as lubricating oil, the work of the Fuel Research Board is making such incidental contributions as the study of possible improvements to the domestic grate, particularly from the point of view of smoke reduction and increased efficiency and the preparation of coal for the market including its 'dust-proofing' to eliminate the raising of dust when the coal is handled. In the field of lighting, the work of the Department touches the life of the ordinary citizen at many points both inside his home and out. Besides, for example, the investigations on daylight problems in clerical work and on the relative merits of light of different colours for various visual tasks, or the work of the National Physical Laboratory on the standardization of electric lamps, the work of the Department in this field has had a most important bearing on road safety. A report issued by the Department has shown that the claims made for a coloured headlight beam for motor-cars in place of a white beam cannot be substantiated, while an investigation concerned with the question of the best colour for street lighting has led to the development of a photographic means of reproducing the actual street scene in all the details affecting an observer's ability to pick out objects in the street which appear and disappear on the surface of the lighted street.

The motorist will indeed find much else that is of interest in the work of the Department, for the Road Research Board's investigations cover such problems as that of skidding, the testing of road surfacing materials, the stresses imposed by all kinds of tyres. For the study of skidding an ingenious apparatus has been developed for taking surface texture prints of a road, while another ingenious apparatus the 'wet road clock' has been developed for recording the periods during which a road was wet, in carrying out tests on the durability of a road. At the National Physical Laboratory, the Department is investigating, too, the noise of motor horns with the object of correlating offensiveness with special physical features, and important research on cylinder wear initiated by the Department in co-operation with the Institution of Automobile Engineers is nearing

completion, while the Research Association of British Rubber Manufacturers has completed an investigation on the ageing of the inner tubes of motor tyres, in which the accelerated tests of ageing have been correlated with natural ageing.

The work of the Building Research Station makes many important contributions to the comfort of the home, both indirectly in its fundamental studies of the properties of building materials such as cement, asphalt, limes and plasters, bricks, roofing tiles, etc., all of which ultimately lead to the construction of more satisfactory houses and also through its studies on the efficiency of buildings from the point of view of the user. The new heating laboratory has carried out extensive tests with hot water radiators as well as on heat transmission through walls and the thermal conductance of windows and a definite programme of work on ventilation has also been undertaken, while jointly with the National Physical Laboratory the Station has initiated an investigation into the subject of noise in flats. Of equal importance to the householder from this point of view is some of the work of the research associations such as that of the British Non-Ferrous Metals Research Association the investigations of which have thrown much light on the corrosion in hot water installations in which copper circulating pipes and galvanized tanks are used in the same system. Experimental work on underground corrosion of lead water pipes, cable sheaths, etc., has also been initiated by the same Association, while the British Electrical and Allied Industries Research Association is making important contributions to public safety and comfort by its detailed investigations of fire risks associated with electrical plant, the protection of overhead lines against lightning by more efficient earthing and the properties required in overhead line wires, and the means of eliminating transformer noise. Again, the work of the Research Association of British Rubber Manufacturers on rubber floorings has led to the preparation of an appropriate British Standard Specification which should assist the general public to obtain a satisfactory article.

Other work carried out at the Building Research Station such as that concerned with methods of cleaning stonework with water without hard scrubbing, where a very promising process is now being tried, or on the failure of paints, bears directly on the amenities of buildings, and in this field the Research Association of British Paint, Colour and Varnish Manufacturers is also making important contributions often in direct co-operation with the Building Research Station. Conclusions from work on the preservation of iron and steel by means of paint have recently been consolidated in relation to practical needs.

No less interesting, however, is the work of the Department which touches upon questions of clothing, whether indirectly, as in the investigations of the British Cotton Industry Research Association on the sizing of rayon warps or on the spinning and cleaning of cotton or in those of the Wool Industries Research Association on the problems arising out of the treatment of wool to confer resistance to shrinkage which has led to a new process for reducing shrinkage, or directly, as in the studies of the British Launderers' Research Association on the washing of woollens or the fundamental properties of detergents. Mention can here only be made further of the Wool Industries Research Association's investigations on substitutes for olive oil for oiling wool, prompted by the shortage of supplies consequent upon the Spanish Civil War, and on the use of rubber in conjunction with wool; to that of the Linen Industry Research Association on spinning a new type of linen yarn; and to that of the British Boot, Shoe and Allied Trades Research Association on walking research, in which good progress has already been made in what is really a long range research. A number of interesting side issues are also being explored. For example, the importance of flexibility in the work has led to the development of a flexibility meter for measuring the flexibility of shoes and another machine is being developed to put shoes through the motions of walking and give soles the treatment they receive during wear so as to obtain an insight into the best combinations of materials and constructions to give maximum durability. In addition, the question of occupational footwear has come to the front during the year, and the Association is giving attention to the design and specification of boots and shoes for different occupations.

It is impossible to go into greater detail into the ways in which the Department, whether through the Research Associations or its special Research Stations or Boards, ministers to our daily needs. If the ordinary citizen is perhaps most likely to be interested in motoring as a means of transport, other forms of transport are equally served by the Department. Reference has already been made to research on the transport of food in storage by sea. Even more fundamental contributions to the design of all classes of ships are made in the William Froude Laboratory at the National Physical Laboratory, where a record number of ship designs were tested. Of the 1,180,000 tons of merchant shipping the construction of which was commenced in Great Britain in 1936, 78 per cent was based on tests in this Laboratory. Experimental work on the influence of waves on the resistance, propulsion and pitching of ships is already leading to improvements in design of different types of ship,

while in the Aerodynamics Department of the National Physical Laboratory not only are new types of aircraft being tested but also important work bearing on the safety of flight has been carried out.

The National Physical Laboratory renders such significant assistance to the work of so many research associations and Government departments, quite apart from its direct scientific assistance to industry that it forms something of a keystone in the structure or organization of the Department. Nor should it be forgotten that much of the less spectacular work, whether in the collection of and dissemination of information, the testing and establishment of standards is of no less importance than work leading to advances or developments which catch the public eye. Indeed, without the foundation of knowledge thus accumulated and the network of services thus established, it is highly improbable that such advances and the important savings to industry and the community which have accrued from the work of the Department would have been achieved to anything like the same extent. The magnitude of these savings can only be illustrated here by reference to one example. The forty to forty-four per cent improvement in efficiency in steam-generating stations in the last two years is attributed largely to the work of the Electrical Industries Research Association, and on the output of units sold in 1935, the higher efficiency represents a saving in coal of more than £7,000,000. Even only ten per cent of this sum exceeds the total annual expenditure of the Association on all its researches, and it is doubtful whether any other expenditure in the national budget brings in anything like the same return as the £600,000 expended by the Department of Scientific and Industrial Research.

Relics of the Mt. Pelé Eruption of May 8, 1902

By Dr. C. T. Trechmann

THE uncouth and sinister-looking volcano of Mt. Pelé (or La Montagne Pelée) occupies the north end of Martinique and rises to about 4,400 ft. The rest of the island consists of lavas, tuffs and limestones which have yielded a fauna of Miocene, probably of Helvetian age. Mt. Pelé had minor eruptions in 1792 and 1852, but began to give warning near the end of April 1902. The great eruption or *nuée ardente* came at 8 p.m. on May 8, 1902. St. Pierre, the one-time capital of the island, with thirty to forty thousand inhabitants, six miles south of the volcano and just within the triangular zone of destruction, was overwhelmed. Further destructive *nuées* occurred during 1902 and 1903, and they were renewed during 1929 and 1930, when avalanches of incandescent stones, some of them as large as haystacks, were projected down to the sea at the Rivière Blanche.

Perret defines a *nuée ardente* as an "avalanche of an exceedingly dense mass of hot, highly gas-charged and constantly gas-emitting fragmental lava, much of it finely divided, extraordinarily mobile, and practically frictionless, because each particle is separated from its neighbours by a cushion of compressed gas."

The well-known spike or spine of hypersthene andesite which was protruded from the summit first appeared about November 3, 1902, but had fallen to pieces by July 1903. It was grooved on one side through squeezing against the sides of the aperture, and reached a height of 900 ft. An eye-witness at Morne Rouge said there were seven luminous points on the volcano's side just before it burst. This seems to indicate that gases were rapidly melting their way through the side of the cone.

These scorched and melted relics have often been attributed in part to the conflagration that burnt up the town after the eruption, but Perret records that bottles were softened and green mangoes converted to charcoal in places where no conflagration occurred. He also records that barefooted negroes entered the town on the afternoon of the day of the eruption, and photographs show quantities of wood and trees in all parts except those nearest the volcano. Reports of the conflagration are probably exaggerated. The sudden rain of intensely hot ashes would probably immediately drive off or distil a great volume of inflammable gas from the large quantities of rum, oil, wood, sugar, coal, etc., stored in the city and this would ignite immediately in contact with the oxygen outside the erupted gases. The only one of the seventeen ships in the bay that got away was the *Roddam*. Part of her cargo consisted of what appears to be china clay; this has been baked to brick and sprinkled with ash, which has combined with the material to form spots of brown melt.

We may safely conclude, therefore, that it was the direct action of the *nuée* that brought about

the curious effects shown by these relics; as it certainly was the cause of the instantaneous death of all the inhabitants—with the possible exception of one survivor in the prison. On a shelf above the entrance of the prison cell, which faces away from the volcano, I found two completely carbonized ship's biscuits. If the prisoner had been equally well baked, there could not have been much life left in him. By some, he is regarded as a negro who had gone in to loot, and got badly burned, and when found made up the story for the benefit of newspaper reporters. It seems likely that no human being in the city survived. One does not like to spoil a good story, but the truth will never be known.

Fig. 1.

BOTTLES PARTLY COLLAPSED AND CONVERTED INTO PSEUDO-WOLLASTONITE. THAT ON THE LEFT HAD CARBONIZED LIQUID IN IT.

It is generally agreed that the erupted gases consisted mainly of superheated steam. Sapper says that hydrogen sulphide and sulphur dioxide were present, with only slight amounts of carbon dioxide and monoxide, but the actual composition and temperature of large-scale eruptions is very difficult to ascertain; 1000° C. may be a good moderate estimate. Bottle glass begins to soften at 670–700° C. Perret has estimated the internal temperature of the crater at not less than 1200° C. The fusion zone in a cement rotary kiln, a bright red heat, is about 1450°–1550° C., and the gases that reached St. Pierre were certainly less than this, but the action so far from the crater seems to have been that of shooting tongues of flame rather than a homogeneous blast. Many objects were not melted or only melted in one part.

Most glass objects are struck and collapsed on one side; lamp shades or bottle necks have been crumpled up while the ash was falling through, and it has been imprisoned in the folds. A bottle tends to split open, but immediately afterwards the ends of the crack are healed up again and the sharp edges are rounded. Ordinary bottle glass is frequently coated with a layer on both sides of fibrous pseudo-wollastonite, beneath which the surface of the glass shows a crackled perlitic-like structure. One can see where the impact of each grain giving off gas has started the devitrification. Bottles that have lain in the hot ashes are reduced to a boiled-up mass of the wollastonite-like material with wisps of unaltered glass here and there (Fig. 1).

Fig. 2.

A SMALL CUT-GLASS LIQUEUR GLASS. THE EDGES AROUND THE COLLAPSED PART SHOW THE TEKTITE-LIKE GROOVES AND PITTINGS.

Heavy brilliant glass objects such as decanter stoppers, knife rests, etc., are often coated with a dull leaden coloured film which Dr. J. A. Smythe has determined as probably silicates of iron, lead, and copper. Blue copper-silicate glass receives a coating of dark red colour, cuprite or copper oxide among which minute glistening crystals of metallic copper can be seen with a lens.

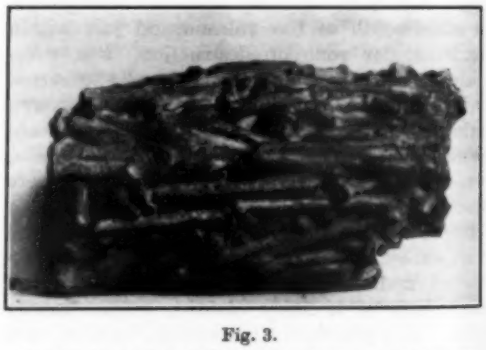


Fig. 3.

A BOX OR BAG OF NAILS CONVERTED TO MAGNETIC OXIDE OF IRON.

Some of these heavy or flint glass objects are eroded with pits or channels or burst bubbles of a very smooth or polished nature suggestive of the structure one sees on tektites or moldavites

(Fig. 2). A decanter stopper completely covered with this darkened film has the knob drawn out sideways and carries grooves resembling those one sees on some meteorites.

Smaller iron objects, nails, wire, locks, etc., are converted to crystalline magnetic oxide, sometimes with a core of metal left (Fig. 3). It seems to be galvanized objects that were most easily oxidized, and around the nails the layer of oxide is sometimes arranged in a spiral form as if the gases had whirled round and completed the oxidation instantaneously. Coins are fused together or become saucer-shaped or are partly melted into blobs or have swollen up, obliterating the design on them; some have a malachite-like coating resembling the patina on ancient coins. A gold Portuguese coin in the St. Pierre museum is merely distorted; gold melts at about 1075° C.

Organic material—biscuits, macaroni, coffee, wafers for religious purposes, etc.—are, when struck by the *nuée*, changed to glistening porous charcoal with little or no loss of outward shape. I have a bottle the upper part of which has been collapsed and 'wollastonitized', but when it was broken open the one-time liquid, which may have been oil, was found to be extremely porous charcoal, but the upper surface was level and intact.

In the St. Pierre Volcano Museum are bottles of perfume with the liquid sealed in them by the sudden impact of the gases. I have a glass door handle which has run like wax, but the part inserted in a silver frame that has been attached to the door is unmelted.

One can still find quantities of human bones in some of the old houses, and these are partly scorched black or partly remain white, indicating the incomplete scorching of the bodies as one sees in photographs. Instead of being burnt off, the flesh and skin seem to have been scorched on to the bones, a sort of mummification process. Hair and clothing are mostly unconsumed; and a box of matches that had not been ignited was found on or near one of these bodies.

These terrible gases, the negation of everything living, were pursuing their natural function of endeavouring to convert everything in their way into igneous material, but their effect must have lasted only a very few minutes.

The effect of such potent gases underground in altering the composition of rocks would bear further inquiry. In Jamaica, in a sea-cliff section below the Lazaretto near Kingston, the Tertiary white limestone has been altered in a peculiar manner. Quite independently of the bedding, the rock grades down into a layer of yellow dolomite, this is succeeded below by a layer 1–2 ft. thick of dense marble, while below this is a dome-like mass of dark splintery material which one can only term hornfels; associated with this or embedded in it are masses of a quartz porphyry. It would seem that gases at a high temperature had come up from below and melted their way into the white limestone. (*Geol. Mag.*, p. 261, June 1936.)

An Historic Mantelpiece at the Royal Institution

By Thomas Martin, General Secretary of the Royal Institution

A FINE mantelpiece in the Adam style, an attractive example of the work of the late eighteenth century, has recently been acquired by, and erected in, the Library of the Royal Institution. It comes from the house of the botanist, Sir Joseph Banks, at 32 Soho Square, London, now unfortunately demolished, in which the Institution was founded. It is thus an object of historic interest in its new home. Moreover the recent vicissitudes of the mantelpiece, particularly of the central Wedgwood panel which forms its principal ornament, are not without interest.

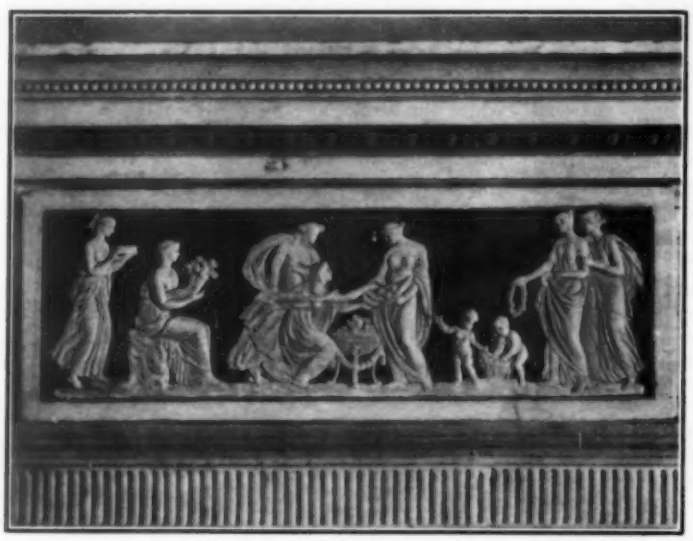
When in 1771, Joseph Banks returned to England after his voyage to the South Seas with Captain Cook in the *Endeavour*, he found himself considerably 'lionized'. He, and his scientific associate, the Swedish botanist, Dr. Daniel Solander, were greatly in demand for the tale of wonders they had to tell. They had brought back a magnificent collection of new and strange species of plants and animals from the antipodes and much valuable information as to the natural resources and native races of the lands they had visited. The full story of their adventures may be read in Banks's "Journal"[1] and in Captain Cook's own "Journal" of the voyage[2].

The voyage of the *Endeavour*, which showed Cook to be the first navigator, no less established Banks as the first naturalist of his age. He had contributed liberally, from the fortune he had inherited, to the scientific expenses of the voyage; and he now became a public figure. In 1778, at the early age of thirty-five years, he was elected president of the Royal Society. In the following year he married, and in 1781 was created a baronet.

He needed a town house which would be con-

venient for his scientific activities and in which his valuable collections and scientific library, with Solander as their curator, could be installed; and took No. 32 in the south-east corner of Soho Square. The design of this house has been attributed to Robert Adam. Probably the Adam brothers reconstructed it for Banks and added the façade; but that it was their work has not been definitely established.

The home of Sir Joseph and Lady Banks speedily became a meeting-place for men of science and affairs in London. Her hospitality and his authority brought to their regular gatherings many of the most distinguished men of the day. At one period, according to Sir Henry Holland, who was later president of the Royal Institution, Cavendish, Wollaston, Davies Gilbert, Sir Humphry Davy, Thomas Young and Sir William Herschel frequented their rooms. Even John Dalton, in his Quaker dress, was seen there occasionally[2]. Committees met at the house. No doubt it was due to Banks's infirmity—for he was a martyr to gout, and in his later years could move about only in a wheeled chair—that even meetings on the business of the Royal Society were occasionally held at the President's home.



CENTRAL PANEL IN THE BANKS MANTELPIECE AT THE ROYAL INSTITUTION

The first meeting of Proprietors of the Royal Institution—those who had responded with a subscription of fifty guineas each to the appeal drawn up by Count Rumford and communicated to the public by the Society for Bettering the Condition and Increasing the Comforts of the Poor—was held under Sir Joseph Banks's chairmanship, in his house, on March 7, 1799. It was by the resolutions taken at this meeting that the Institution Rumford had conceived may be said to have been actually formed. Subsequent meetings of the Managers of the new body were held at 32 Soho Square, until the house in Albemarle Street was occupied.

Sir Joseph Banks had had his house specially arranged for the purposes of his scientific meetings and entertaining, as well as for accommodating his collections. In particular, on the first floor, he had constructed a large and lofty room, magnificently decorated, known as the 'council chamber'. The domed ceiling of this room was a triumph of design and the most beautiful decorative feature of the house. On the same floor was another smaller room, the drawing-room.

When, before the demolition of the house in 1937 (see NATURE, **139**, 280; 1937), the decorative fittings it still contained were sold by auction, the mantelpieces from the council chamber and the drawing-room were, by the generosity of Sir Robert Hadfield, purchased and presented, the former to the Royal Institution, the latter to the Royal Society.

The mantelpiece from the council chamber was found to have, as its central ornament, a white marble panel of a reclining nymph. It happens that *Country Life* had published, on September 27, 1913, a description of 32 Soho Square as it then was, including a photograph and description of this mantelpiece. The central panel was of different design, described as "a Wedgwood in green and white". It was obvious that the original had been removed and replaced by another.

It was disappointing to find that the mantelpiece was not now as it had been in Banks's lifetime, and efforts were made, without much hope of success, to trace the original panel. It was found, on inquiry, that in 1914, when the house was empty for a period, thieves broke in and stole the Wedgwood panel. They also loosened the whole mantelpiece preparatory to removing it on the following night, but were prevented, and left it undamaged.

Failing the original, it was hoped to obtain a replica of the panel. The help of Dr. John Thomas, of Stoke-on-Trent, who has made a study of the early Wedgwood designs, was solicited and generously given. Thanks to the willing co-operation of the directors of Josiah Wedgwood and Sons, Ltd., Dr. Thomas, who devoted much time and skill to the problem, was completely successful

in tracing the history of the panel. He was provided with an enlargement from the *Country Life* photograph, and concluded, from a comparison of this with other designs, that the panel, which was of a 'sacrifice' type popular in the eighteenth century, was most probably made to the special order of Sir Joseph Banks by Josiah Wedgwood. It was a composite design of white jasper figures against a green, instead of the more common blue, background, composed of six separate groups worked up into one theme or ensemble representing a sacrifice to Flora. For each of the groups, consisting of vestal figures carrying offerings, and Bacchanalian boys, a separate mould had been used, and the six, when assembled, composed a tablet about 1 ft. 9 in. wide and 7½ in. high. The design may be taken to symbolize Banks's interest in flowers and his pursuits as a botanist.

Dr. Thomas crowned his success by discovering, after a search in the dusty mould rooms of Messrs. Josiah Wedgwood and Sons, the actual moulds which had been used for the tablet. From these, the firm undertook to prepare new working moulds and attempt the manufacture of a replica.

All hope of recovering the original had been abandoned, and the order for the replica had actually been given, when information was received from a firm of dealers in London, of whom inquiry had previously been made, of a panel which had come into their possession, which they believed to be the missing one. It was taken to the Royal Institution and closely compared with the photograph. It corresponded in every detail. It must be either the original or a duplicate made at the same time. It was compared for shape and size with the recess left in the stonework of the mantelpiece to receive it. It fitted exactly. There could be no reasonable doubt that it was the original.

Thus the panel, a beautiful original specimen of Josiah Wedgwood's art and in excellent preservation, as the accompanying figure shows, is restored to its rightful position after a lapse of twenty-four years, and the mantelpiece, complete as it stood in Sir Joseph Banks's council chamber on the day the Royal Institution was founded, finds a new and appropriate setting in the Institution's house in Albemarle Street.

[1] "Journal of the Right Hon. Sir Joseph Banks". Edited by Sir Joseph D. Hooker. London: Macmillan, 1896.
[2] "Captain Cook's Journal during his First Voyage round the World". Edited by W. J. L. Wharton. London, 1893.
[3] "Recollections of Past Life". By Sir Henry Holland. London, 1872. Pp. 212-216.

Obituary Notice

Dr. C. Lallemand

DR. CHARLES LALLEMAND died on February 1 at his country house in Bussy par Joinville (Haute-Marne), after a long and painful illness, in his eighty-first year. Few men of science of modern times have left a wider international reputation behind them, and fewer still so clear and definite a personal impression.

Lallemand was early in showing his marked ability. At seventeen years of age he was admitted to the Ecole polytechnique, from which he was posted to the Corps des Mines, and passed out first among his contemporaries. It is remarkable that he should have started at once on his final career, and should have done so as chief of his own department. He was immediately appointed secretary to the inter-departmental committee then sitting to discuss the formation, and terms of reference, of a department to undertake the first-order levelling of France. The circumstances of that time may be briefly recalled.

France had then no national levelling department, nor was the Service Géographique de l'Armée (responsible for the triangulation) charged with its execution. Twenty years after Prof. Whewell's levelling from the English to the Bristol Channels, and only two years before the Ordnance Survey was to complete the first-order levelling of Great Britain, the French Ministry of Public Works appointed that eminent geodesist, Bourdaloué, to level the main roads and canals of France (1857). His network of 15,000 kilometres was finished in 1864, but he left behind him no permanent arrangements for extension or upkeep. In 1878 an ambitious project of public works called for levelling much more general in extent, of a higher precision, and so continuous in policy and maintenance as to necessitate a responsible and permanent department.

The inter-departmental committee, of which mention has been made, was formed, sat for six years, and reported in 1884. As a consequence, the Service du Nivellement was inaugurated, and Lallemand, who had won the confidence and esteem of all his colleagues, was made director at the age of twenty-seven years. Much of the preliminary work he had already done. He had outlined, in detail, the methods to be followed, and the routine of computation. On his appointment as director, his first duty was to modernize, and indeed practically to re-design, French geodetic levelling instruments and staves. He perfected and introduced many semigraphic solutions for the computation of corrections of the minor orders, and his formulæ for the classification (in

precision) of levelling nets were adopted (internationally) in 1912. His administrative and executive measures were as successful as his technical. The programme, as originally outlined, was to last for ten years and to include some 800,000 kilometres of circuits. There have, however, been many financial difficulties, and Lallemand has not lived to see its completion. Some idea of the precision of his first order may be gained from the final misclosure of 50 centimetres in his 4,000-kilometre circuit of France (1/8 M.). It is claimed for his administration that it reduced errors to a third of those prevalent in Bourdaloué's net, whilst it greatly reduced expense.

In 1898, Lallemand was called upon to reorganize the cadastral survey of France. The old communal system, originally introduced by Napoleon, rested merely upon chained triangles. The 1/2500 *parcellaires*, or property plans, had more in common with our tithe surveys than with the reliable Ordnance plans, and it fell to Lallemand to introduce a dependence on the triangulation of the Service Geographique, to advocate contouring, and generally to modernize a none too efficient regime.

It was a bitter disappointment to Lallemand, and a serious loss to France, when credits were cut off, and the cadastral survey was allowed to fall back into decay in 1907.

In 1910, Lallemand was elected a member of the Academy of Sciences, and in 1917 a member of the Bureau des Longitudes. Of both these bodies he was eventually to become president. In 1914, it may be said that Lallemand was as unquestionably the authority on levelling as was Helmert in geodesy generally.

In 1919, therefore, Lallemand, collaborating with the founders of the International Research Council, brought with him the reputation of first-class geodetic ability combined with proved administrative success. He was chosen, unanimously, president of the International Union of Geodesy and Geophysics, and it is in that connexion that he is best known in international circles to-day. He retained that position for fourteen years, and his great personal and scientific abilities made him a magnificent success. He was an astonishing linguist. At Rome, Madrid, Prague, Stockholm and Lisbon his presidential addresses were given largely in the languages of the countries concerned. As one would expect from so strong and able a man, he had his differences with his colleagues. Yet none who may have differed from him in detail would fail to pay the warmest tribute to the dignity, charm, scientific eminence and administrative ability which he put, whole-heartedly, at the service of international science. The Union of Geodesy and Geophysics, cherishing his memory with affection and admiration, knows that it owes to him much of its present position.

H. St. J. L. W.

News and Views

The Scientific Delegation to India

THE Council of the British Association has forwarded the following resolution to the Indian Science Congress Association and to Government authorities, institutions and individuals who helped to make possible the recent visit of the Scientific Delegation to India: "The Council of the British Association have learned with gratification of the complete success that attended the visit of the Scientific Delegation to India, the members of which through the invitation of the Indian Science Congress Association, were enabled to co-operate in its Jubilee Meeting in Calcutta, to visit many places of scientific and historical interest in India, to become acquainted with the work of many universities and other institutions, and to make or renew personal contacts with large numbers of Indian scientific workers and leaders of thought. The Council are glad to hear of the opinion, widely expressed in India, that much good would result from the visit, and this belief the Council heartily reciprocate. The Council desire to endorse the expressions of gratitude which have already been transmitted on behalf of the Delegation, to the Government of India, to all other participant authorities and individuals, and very specially to the executive of the Indian Science Congress Association."

Rearmament and Research: Comparative Costs

IN a White Paper issued in February 1937, it was estimated that Great Britain's total expenditure on defence during the five financial years 1937–41 would be £1,500,000,000; the estimate for 1937 was £278,250,000. According to the "Statement Relating to Defence" issued by the Government last week, the estimate for the present year is £343,250,000, and £8,500,000 is provided for air raid precautions services alone. Further, it is stated that the expenditure in 1939 is likely to be even greater, and that the total cost of the five years' rearmament will probably exceed the original estimate made in 1937. The Statement gives in general terms an outline of the ways in which the money is being spent and of the progress of the rearmament schemes on which Great Britain has embarked. This document will be read with mixed feelings, among them being dismay that the international situation should, in the opinion of responsible men, require the expenditure of such vast sums on armaments and defence. One cannot help contrasting this enormous outlay with the amount spent annually on scientific research, any item of which may eventually prove of outstanding worth. Elsewhere in this issue (p. 432) is an article on the work done during 1936–37 through the Department of Scientific and Industrial Research,

based on its latest report. From the report, it will be seen that, for the very modest expenditure of £600,000 during the year, investigations on food, clothing, housing, transport, etc., have produced results of general value to the health, happiness and economic well-being of man. It is a sad commentary on the state of civilization that, as a result of national animosities, the Government of a leading State and world power should spend in one year some five hundred times as much on armaments and defence as on potentially productive scientific investigations.

Marble Mantelpieces from Banks's House

BESIDES being for thirty-six years (1821–1857), the home of the Linnean Society, No. 32 Soho Square, London, which was demolished in 1937 (NATURE, 139, 280; 1937) was historically connected with both the Royal Society and the Royal Institution. From 1777 until his death in 1820, it was the town house of Sir Joseph Banks. Traditionally, Council meetings of the Royal Society were held there, and although this has not been confirmed, there can be no doubt that, during Sir Joseph Banks's long presidency, meetings on the business of the Society were held at the President's home. The Royal Institution was founded there at a meeting held under Sir Joseph's chairmanship in March 1799. Before it was demolished, the decorative fittings of the house were sold by auction. Two marble mantelpieces were purchased at the sale and presented by Sir Robert Hadfield, one to the Royal Society and the other to the Royal Institution. That given to the Royal Society is to be placed in the Officers' Room of the Society's apartments in Burlington House in due course. The other, it was reported to the members of the Royal Institution at the General Monthly Meeting on March 7, has now been re-erected in the Library of the Institution. An account of No. 32 Soho Square, and of the mantelpiece at the Royal Institution, which has had a most interesting history, is given on p. 437 of this issue.

The Milk Problem in Great Britain

LIEUT.-COLONEL C. WALEY COHEN, in an article in the February issue of the *Nineteenth Century and After*, surveys and discusses the problem of the milk supply in Great Britain. He points out that the milk supply of England and Wales has been reviewed by no fewer than five Royal Commissions and Committees during the last twenty years, and has been the subject of several departmental orders and of legislation during the same period. All this has rendered the farmers nervous and the public bewildered, with the result that the consumption of liquid milk in Great Britain is low, and the price high, as compared with some other countries. A change has also taken place in the method of distribution and supply, for prior to 1900 supply of liquid milk to the consumer was mainly direct, by 1923 producer-retailers supplied only 40 per cent, and to-day only 20 per cent, of the total requirements, the remainder being bulked, often conveyed long distances, and then distributed. Bulking of liquid milk is the key to many of the difficulties surrounding the milk supply: it gives rise to the major problem of milk-borne diseases, and was the proximate cause of the necessity for, and creation of, the Milk Marketing Board. The Great War also created an impetus to the importation of cream, butter, cheese and other milk products from the Dominions and foreign countries.

BULKING of milk largely increases the danger from milk-borne diseases, for a small addition of infected milk will infect the whole of the milk to which it has been added, amounting, perhaps, to 2,000 gallons or more. This, together with the time that elapses between the milk leaving the producer and reaching the consumer, renders some form of heat treatment necessary. In the case of bulked milks, efficient pasteurization is therefore desirable, and a scientific system of pasteurization should be enforced. The risk of milk-borne disease in rural, and in less congested urban, areas is low, as bulking is rare. Efficient pasteurization in small urban, and in rural, areas is expensive, and would deprive these areas of the reduction of 4*d*.–6*d*. per gallon in retail milk price which they now enjoy. The grading of milk, and the accredited scheme, receive some criticism. Colonel Cohen desires the establishment of some better 'concordia' on the medical side between experts, practitioners, medical officers of health, bacteriologists and veterinarians; on the commercial side between producers, distributors and manufacturers; and generally between all these and administrative officials. Nothing should be done to restrict or discourage the production of milk in Great Britain, for the industry is outstanding in the agricultural economy of the country, and the income from milk and dairy produce forms no less than 28 per cent of the nation's agricultural income. Finally, it is suggested that there is much scope for the establishment of a permanent Milk Commission, with a real administrative competence.

Films and Folk-Lore

IT is remarkable that little use has been made in Great Britain of the cinematograph for recording systematically the survivals, now rapidly diminishing in number, of customs and festivals formerly observed among the people. British anthropologists were not slow to appreciate the possibilities of the cinematograph in field work: and more than thirty years ago the Daniels-Seligman anthropological expedition to New Guinea secured some striking records, as also did the late Sir Baldwin Spencer in the Northern Territory of Australia in an illuminating series of films of native ceremonial dances shown in London in 1914. In the home-field, however, notwithstanding more favourable conditions, this potential auxiliary of scientific study of folk-custom has been sadly neglected, although the commercial film has shown appreciation of the spectacular value of brief episodes of folk-dance and ceremonial for the news-reel. Familiar as these were, the value to the student of the film taken for purposes of scientific record only,

and not as part of a public performance, was brought out by some of the Continental films, especially the instrumental films, shown at the International Folk-Dance Festival in London in 1935, which came as something of a revelation. It is satisfactory to note, therefore, that an attempt is to be made to remedy the deficiency in the equipment of folk-lore studies in Great Britain by an endeavour to secure a record of folk survivals, which will include not only folk-dances and folk-customs, but also folk-crafts, which are in danger of extinction. The proposal, it is announced in a communication to *The Times* of March 7, is put forward on behalf of the Folklore Society, the English Folk-Dance and Song Society and the National Film Library. Sound films, it is also suggested, might be made of such activities as the almost extinct art of hand-bell ringing and of folk-dances *in situ*. The expense of carrying out such a scheme obviously will be considerable, and it is hoped that private benefaction will be forthcoming. In view, however, of the scientific and historical interest of local custom, whether ceremonial or industrial, the local museum, especially where an attempt is made to illustrate local antiquity and history at all adequately, might regard a subsidy in aid of a local film as a legitimate charge on its financial resources.

The New Commonwealth

THE eighth in the series of broadcast talks on "The Way of Peace" was given on March 3 by Lord Davies, who spoke on the New Commonwealth. This is, he said, a voluntary, international society, composed of members living in forty-six different countries, who have banded themselves together in order to enlist the support of public opinion for the establishment of two institutions—an equity tribunal or commission, and an international police force—as part of the permanent machinery of the League of Nations. No Government could carry on for a single week unless it possessed institutions capable of effecting changes in its laws, and the means of upholding them. How then can we expect the League to inaugurate the rule of law if its members refuse to give it those institutions essential for carrying out the responsibilities they have entrusted to it? War can only be prevented by establishing international law and order on the same principles, and by the same methods, which have been successfully applied in the development of every civilized community. Lord Davies then dealt briefly with the two institutions in the New Commonwealth programme. The task of the equity tribunal would be to deal with any disputes which the League Council fail to settle by the existing procedure of negotiation and conciliation. The aim of the second point of the New Commonwealth programme, said Lord Davies, is the substitution of co-operative for competitive armaments. This can best be done by means of a police force under the control of the international authority. Only in this way, he considers, can the rule of law be established and the downfall of Western civilization averted.

Gliding and Soaring Flight

AT the Friday evening discourse at the Royal Institution on March 4, Prof. D. Brunt discussed "Gliding and Soaring Flight". As the modern sailplane has a sinking speed in still air of 2–3 ft. per second, it will soar in an ascending current which rises faster than this modest limit. Three types of ascending currents occur in the atmosphere. Where the wind blows against the slope of a hill, it follows the contour of the ground, and if the air rises faster than the sinking speed of the sailplane, the latter can soar over the hill slope. Such a flight of 9 hours 48 minutes was carried out at the international competitions in Germany last summer, by Messrs. Fox and Murray in a Falcon III two-seater. When the air near the ground is heated until the rate of fall of temperature with height exceeds 5·6° F. per 1,000 ft., the air becomes unstable, and currents of warm air rise, and, if damp, give rise to clouds. Under the cumulus clouds then formed, the sailplane can mount in the rising air. When the wind increases with height the clouds are in long rolls, which have ascending air under their whole length, and in this air the sailplane can soar along the whole length of the cloud. In the rear of a depression, at the cold front, where the cold air pushes under warm air and forces it to rise, the rate of ascent of the warm air is often sufficient to enable a sailplane to soar. The British record for distance of soaring flight is 104 miles and was set up by Mr. Philip Wills. The world's record for distance, 405 miles, was set up by a Russian pilot in May, 1937.

Asymmetric Sideband Broadcasting

MR. P. P. ECKERSLEY in a paper read to the Institution of Electrical Engineers on March 2 said that the present methods of working permit few, except local radio broadcasting stations to be received without interference from other transmitters operating in contiguous frequency channels, unless the upper frequencies of modulation of the wanted station are severely attenuated. In this case the reproduction lacks intelligibility and naturalness. This can be mitigated without introducing audible harmonic distortion by utilizing the asymmetric sideband system of transmission to cut away with the aid of electrical filter circuits part of one sideband of the frequency spectrum radiated. In a previous paper, the author has shown how 'asymmetry', either of phase or of magnitude, between two sideband components is related to harmonic distortion. It is proportional to depth of modulation. He proved that as the sideband frequency becomes more and more removed from the carrier frequency, it may be more and more attenuated while the distortion can be made to remain constant and small. The author suggests that it is better to face the occasional minute deteriorations in quality given by the asymmetric system than to suffer from the continuous hissing and splitting sounds brought about by existing inter-station interference. The public insists that the radio-set exists to give pleasure. The attention that a user gives to a programme is de-

termined partly by the quality of reproduction, but probably more by the freedom it enjoys from interference from extraneous sounds. It is primarily programme interest which pleases, but interference is very objectionable however good the programme. The author acknowledges his thanks to the B.B.C. for providing the funds for the construction of test apparatus. He also thanks the Countess von Zeppelin for her mathematical investigation, given in an appendix, resulting in a most useful expression for the distortion component.

Reclamation of Tidal Lands

In a lecture delivered before the Royal Society of Arts on February 23, Mr. Oscar Borer described the process of land reclamation work as applied to the coastal frontages on both sides of the North Sea, tracing the origin of such operations to the time of the Romans under whose direction a bank was constructed across the Wash at some date prior to A.D. 359, and when other embankments were made between Lincoln and Norwich, aggregating not less than 50 miles in length and having a height of 10 feet. After the cessation of the Roman occupation, very little additional protection seems to have been undertaken along the British coastline until the seventeenth century, when during the reign of James I and afterwards, large tracts of marshlands, amounting to 35,000 acres, were excluded from tidal influence. During the eighteenth and nineteenth centuries, other areas approximating to 10,000 acres were reclaimed. Of the total quantity enclosed since Roman times, 8,000 acres was marshland in Norfolk along a frontage of ten miles, and 37,000 acres in the South Holland district of Lincolnshire with a frontage of nineteen miles, the remainder being in the North Holland district. In the Netherlands, from Roman times until the beginning of the fifteenth century, extensive areas were lost to cultivation through floods, the surface level of the land having sunk so that it was easily invaded. Early dikes made to offer defence against the sea broke down, and in this way the Dollart was formed in the twelfth or thirteenth century. The Zuider Zee, which had once been largely dry land, was inundated about the same time. The largest 'polder' recently reclaimed in this area is the Wieringermeer, in the north-west corner. It has an area of 48,000 acres and was dried in 1930. A second enclosure in the north-east corner was started in 1936, and it is expected that in due course another 110,000 acres will be available for agriculture. On the German North Sea coast, 8,000 acres has been embanked since 1900 in the province of Schleswig-Holstein.

The Disappearing Fauna of Africa

The problem of the disappearing fauna of Africa formed the subject of a lecture before the University of London Animal Welfare Society on March 7. It has been common knowledge for years that the status of many of the big African animals was precarious. The last quagga died in 1882, and the three big pachyderms have been killed off at an alarming rate. Not only are the indigenous beasts being wiped out under the 'protecting' eye of a white civilization, but also the majority of many species are dying unnecessarily cruel deaths at the hands of the African native, working with old-fashioned guns and pitfalls and traps. Possibly only a few thousand gorillas remain alive to-day, in the Cameroons, where they are exploited by man, and in the Parc National Albert, where they are protected by the Belgian Government. The elephant has disappeared from most of its old haunts. In the three British dependencies a minimum of 6,000 a year are killed, chiefly in the 'control campaign'. Tanganyika and the lake swamps are the last haunts of the hippopotamus, and unless help is forthcoming this will eventually disappear. On November 8, 1933, the London Convention for the Protection of the African Fauna and Flora was signed. The first of a series of subsequent international conferences should have taken place before November 1937. No conference has been held, the reason given being that the British Government intends to summon a conference on tropical Asia and the western Pacific, certain of the experts interested in those regions being also interested in Africa. At the meeting, the Society passed a resolution calling upon the Government to take urgent steps for summoning the London Convention for the Protection of the African Fauna promised for November 1937.

Locust Outbreaks in Africa and Western Asia

The recent report of the Committee on Locust Control is the sixth of its kind which deals with locust outbreaks in the regions mentioned. In the present instance it covers the year 1936 and the early part of 1937, and has been prepared by Dr. B. P. Uvarov and Miss W. Milnthorpe. The report is a survey of the conditions in the territory named and is based upon the accumulated data which has come to hand as the result of international organization. It appears that the general situation, in so far as the African migratory locust and the red locust are concerned, is steadily improving. Particular stress, however, is laid on the beginning of a new outbreak of the desert locust which has been definitely proved to be forming in the Sudanese-Arabian area. It has been due to the regular system which is operating for the recording and collection of all data relating to locusts, and its centralization in a single institution (the Imperial Institute of Entomology), that the first signs of this outbreak have been recognized and warnings issued to all countries likely to be affected by the locust in question. The concerted measures which are being undertaken in order to endeavour to fathom the causes of locust outbreaks merit every support. The elaborate organization which has been built up and got into working order at the prime instigation of Dr. Uvarov provides the only sound method of attack—mere remedial measures are temporary palliatives and leave the locust menace unimpaired. At the present stage of the work, no effort should be relaxed, and it is up to the countries directly interested to see that the necessary funds are maintained. The report is available, price 3s. net, and is published by H.M. Stationery Office.

Chronica Botanica

THE first re-organized number of *Chronica Botanica* (4, No. 1, February 1938. *Chronica Botanica* Co., P.O. Box 8, Leyden) has recently been issued. This international journal, which deals with all branches of botany, horticulture, agronomy and silviculture, is now bimonthly, and the annual subscription has been reduced from fifteen to seven guilders. Most of the contributions are in English. The present number opens with a short account of the new Association for the Study of Systematics in Relation to General Biology (see also NATURE, **140**, 163; 1937) by W. B. Turrill. Sixteen pages are devoted to correspondence and eleven pages to discussions. Notes from contributions of botanical interest to other journals occupy five pages. The reports of recent international congresses and announcements of forthcoming congresses are full and informative. Of outstanding interest is the section of news of more general interest from botanical and related institutes throughout the world. In fact, this section is, so far as we know, unique, and should prove of inestimable value to botanists, especially those engaged in research. The obituary announcements and notices are very full, and several portraits are included. Similarly, recent appointments and resignations are announced. This journal has achieved a world-wide reputation in a very short time. For this, the editor (Dr. F. Verdoorn) is to be congratulated; but it is well deserved. He and his advisory editors must be indefatigable in their efforts to glean botanical information from all parts of the world, resulting in a journal of plant science which all interested in plants will find of absorbing interest and great utility.

The *Tree Lover*

THE editorial in the *Tree Lover* (vol. 2, No. 21; 1937) deals with several points in connexion with trees and forestry principles in the opening words "More and more do Trees become 'news' and the claims of forestry find mention in the Press". This is a position which NATURE realized more than a decade ago and has since kept in close touch with this important subject with the object of educating a public who had completely lost all 'forest sense'. The editor perforce alludes to the appalling dust bowls in process of creation in the United States and Canada. But he is equally concerned over the threatened final demolition of Milton's Elm, 500 years in age, at Chalfont St. Giles, the remaining 12-foot stump being in danger owing to the expressed intention of widening the road. As the editor states, "The crisis of Milton's Elm is typical of what is happening all over the Country. One can only hope that ere long there will be a reaction from the ruthless cult of speed". He mentions the several bodies who are taking up the campaign against the increasing vandalism of the builder and road-maker. This autumn quarterly number deals with such matters as Gloucestershire woodlands, Whiligh and its trees, evolution of the moor, and the Royal Gardens of Sandringham and Windsor.

Medical Research in South Africa

THE annual report for 1936 of the South African Institute for Medical Research, Johannesburg, of which Sir Spencer Lister is director, gives an account of the routine and research work pursued there. The bacteriology and epidemiology of pneumonia in local mine natives are continuously studied by Dr. Ordman. The use of prophylactic pneumonia vaccine is increasing in the mines, and a number of satisfactory results continue to be recorded. Routine specimens examined for plague infection numbered 144 from human sources and 1,908 from animals, positive results being obtained in 49 human cases and in 5 rodents. Strains of the plague bacillus maintained in the laboratory have been found by Dr. Pirie to undergo a steady diminution in virulence. Much work has been done by Dr. Mavrogordato upon mine dust and its relation to silicosis in miners' lungs, and Mr. Rabson has determined the size of the particles present in the dust. Ninety per cent of the mass of dust is found to consist of particles of 4μ and less. Malaria research and the prevalence and species of mosquitos in certain districts, the venoms of snakes, and researches on tumour agents, are some of the other subjects that have been investigated.

The Management Library

THE Management Library which was opened to general use by industry in June 1932 has issued a report on progress in the five years ended June 30, 1937. 1,000–1,500 books are now out on loan at a time, or a total of 15,000 volumes in the year, and 1,250 copies of the monthly review are issued to members, subscribers to which come from France, Belgium, Holland, Switzerland, Sweden, Norway, India, Japan and elsewhere. The reviews are now framed to outline the chapter headings, evaluate new contributions to knowledge and to indicate the departments or persons in industry to whom the book is of special value. Although serving various institutions and associations, the Library has no direct affiliation with any other organization. Income from subscriptions has grown from £150 in the first six months to £1,000 in 1936 and £684 in the first six months of 1937.

Education in the U.S.S.R.

ACCORDING to the Soviet Union Year Book Press Service the educational services budget this year shows an increase of more than thirty per cent compared with that of last year (13,916 million roubles), and 3,613 new schools are to be built to provide accommodation for more than a million pupils, namely, 663,740 in rural areas, 518,950 in urban areas, and 35,000 children of railway workers scattered throughout the country. Special schools for railway workers' children already accommodate more than a million. The total urban schools attendance is 8,800,000, the rural schools 21,200,000. The accommodation to be provided by the new schools will therefore increase the capacity of the present urban schools by 6 per cent and that of the other schools by 3 per cent.

(*Continued on p.* 469)

NATURE

SUPPLEMENT

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Pascal and Seventeenth-Century Physics

The Physical Treatises of Pascal

The Equilibrium of Liquids and The Weight of the Mass of the Air. Translated by I. H. B. and A. G. H. Spiers, with Introduction and Notes by Frederick Barry. (Records of Civilization: Sources and Studies, edited under the auspices of the Department of History, Columbia University, No. 28.) Pp. xxviii+181. (New York: Columbia University Press; London: Oxford University Press, 1937.) 16*s*. 6*d*. net.

THIS volume is a welcome and notable addition to the series entitled "Records of Civilization" published by the Columbia University Press. For the most part, the preceding volumes have concerned themselves with history-sources of very varied range and outstanding interest; in this, the twenty-eighth volume of the series, the editors have adventured upon a notable story in the history of science, and have performed their task in such a way that a reader who has 'preferences but no exclusions' will not readily exchange this volume even for the 'History of Yaballaha III'.

The title of this study is self-explanatory, and the editors have exercised a wise discretion in choosing for this first experiment a story which can be rounded off in comparatively small compass. Here we have, for example, in the space of about two hundred pages, not only the treatises on the equilibrium of liquids and on the weight of the mass of the air, and the "Story of the great Experiment . . . devised by Monsieur B. Pascal . . . and carried out by Monsieur F. P. on one of the highest mountains in the Auvergne, commonly known as Le Puy de Dôme", but also a series of records of certain barometric observations made simultaneously in Clermont, Paris and Stockholm, and an account of "New Experiments, made in England . . ." Following these come three carefully selected appendices. The first is a translation of the relevant portions of Stevinus's work on statics, wherein, following a delightfully formal set of carefully arranged definitions and postulates, one finds the theorems of elementary hydrostatics developed in a series of graduated propositions such as "A solid body *minugrave* to the water in which it lies is equiponderant to the water of which it takes the place". A second appendix gives a translation of Galileo's "Remarks on Nature's Abhorrence of a Vacuum", and a third gives a translation of the text of Torricelli's letter of June 11, 1644, to Ricci on the pressure of the atmosphere, an excerpt from Ricci's answer (". . . it seems . . . that one could exclude the action of the air . . . on the . . . surface of the quicksilver in the basin by placing on this vessel a cover . . . The air above the basin would . . . gravitate no longer on the surface of the quicksilver, but upon the cover; and if then the quicksilver remains suspended . . . the effect could no longer be attributed to the weight of the air . . . ."), and Torricelli's reply of June 28.

It seems, then, that the reader is provided with much of the material which will give him the background of the contemporary outlook and achievements which is so necessary in order to appreciate completely the magnitude and importance of Pascal's contribution to the advancement of knowledge in this particular region.

It is a privilege to have the opportunity of following Pascal's method in general hydrostatics, but the work on the weight of the air leads to a climax of surpassing interest, though, truth to say, it would seem that the worthy Monsieur Perier's contribution to the Puy de Dôme

experiment has scarcely received the consideration which it merits. Perier, Pascal's brother-in-law, was "His Majesty's Councillor in the Court of Aids of Clermont-Ferrand", and to him Pascal wrote the letter dated November 15, 1647, in which he suggests that a barometer shall be set up "several times over in one day, with the same tube and with the same quicksilver, sometimes at the base and sometimes at the summit of a mountain at least five or six hundred fathoms high". He remarks that a fall in the barometric height will be decisive, "for it is quite certain that there is much more air that presses on the foot of the mountain than there is on its summit, and one cannot well say that nature abhors a vacuum more at the foot of the mountain than at its summit"; and he remarks further, "I say nothing about the means of performing the experiment, because I well know that you will omit none of the precautions necessary to carry it out with precision".

Perier certainly omitted nothing. He prepares basins and two glass tubes, sealed at one end, and each four feet long. He rectifies six pounds of quicksilver, and at eight o'clock of the morning of September 19, 1648, he proceeds to the garden of the Minim Fathers, where he sets up his two tubes side by side in the same vessel, and remarks that each records a barometric height of twenty-six inches and three and a half lines. He repeats the experiment twice, and sets up one of the tubes in the garden for 'continuous observation', requesting the Reverend Father Chastin, "a man as pious as he is capable, and one who reasons very well upon these matters, to be so good as to observe from time to time all day any changes that might occur". He then proceeds, accompanied by a miscellaneous assemblage of clerics, lawyers, and one general practitioner, to the summit of the Puy de Dôme. Here he repeats the 'vacuum experiment' and finds a barometric height of twenty-three inches and two lines.

Apparently the emotions engendered by a successful seventeenth-century experiment on the spring and the weight of the air find similar, if more vigorous, expression in France as in England, for the whole company is carried away with wonder, delight and surprise. He repeats the experiment six times in all, "once in the shelter of the little chapel that stands there, once in the open, once shielded from the wind, once in the wind, once in fine weather, once in the rain and fog which visited us occasionally". In all these experiments he finds the same barometric height—twenty-three inches and two lines. (It is to be remembered, that between each of these experiments, the apparatus is dismantled, and the tube refilled.) During the descent, the experiment is carried out thrice at an intermediate station, and yields a height of twenty-five inches. On returning to the Minims, he finds that the barometric height has there remained constant at twenty-six inches three lines and a half. He repeats the observation with the Puy de Dôme tube, first immersing it in the vessel in which the tube for the 'continuous experiment' was standing, and then in the vessel which had been carried up the mountain. In every instance the observed height was twenty-six inches, three lines and a half. The whole story affords an admirable illustration of a carefully controlled experiment and it detracts nothing from the originality of Pascal to say that Perier's attendant bark should certainly "pursue the triumph and partake the gale" of Pascal's immortal achievement.

The book is not over-annotated; it has a useful bibliography, and the production is excellent. It is to be hoped that the volume will be the precursor of many others devoted to the history of science—a proportion of one in twenty-eight scarcely expresses the relative importance of science in the records of civilization.

A. F.

Is the Universe Expanding?

The Observational Approach to Cosmology
By Edwin Hubble. Pp. viii + 68 + 7 plates. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 6s. net.

THE present volume contains the Rhodes Memorial Lectures delivered at Oxford in the autumn of 1936, and is a sequel to "The Realm of the Nebulæ" based on the Silliman Lectures of the autumn of 1935. The earlier book was a record of what Dr. Hubble describes as a rapid reconnaissance of the extra-galactic nebulæ; the book under review presents, one year later, the results of a much more detailed and thorough observational survey, representing possibly the extreme limits attainable by the 100-in. telescope of Mount Wilson Observatory.

In the earlier book, there was expressed a guarded doubt of the current interpretation of the observations as evidence of the expansion of the

universe; in the new volume this doubt is magnified into the central theme. The position can be described quite simply.

The observations are two-fold in character—photometric and spectroscopic. The former lead to estimates of the distances of the nebulæ; the latter give the red-shifts of the observable spectrum lines. If the red-shifts are *not* velocity-displacements due to the recession of the nebulæ in the line of sight, the distribution of nebulæ is inferred to be essentially uniform and the universe to be unlimited in extent. Moreover, with this original assumption the observations show that the red-shifts are simply proportional to the nebular distances, and this law of red-shifts implies a hitherto unexplained principle of Nature, namely, that the energy of a light quantum diminishes with the distance traversed.

On the other hand, if the red-shifts *are* true velocity displacements, the law of the red-shifts is no longer linear and the resulting picture of the universe reveals disturbing features as to its comparatively small scale both in time and space.

The formulæ in the two cases are respectively

$$d\lambda/\lambda = ar \quad . \ . \ . \ . \ (1)$$
$$d\lambda/\lambda = br + cr^2 \quad . \ . \ . \ (2)$$

where $d\lambda$ is the observed displacement for a wave-length λ, r is the distance of a nebula and a, b and c are constants obtainable from the observations. It might be expected that a direct test of the two hypotheses could be furnished by the observations, for, of two identical nebulæ at the same distance from us, one stationary and the other receding with a high velocity, the latter should appear the fainter. But apparent luminosity is, at present, the only practicable criterion for deriving the distances of the very remote nebulæ and so this direct test cannot be applied.

Now, irrespective of the interpretation assigned to the red-shifts, the apparent luminosity of a nebula is diminished as a result of the quantum relation, $E\lambda$ equals a constant, in which E denotes the energy of a quantum which leaves the nebula with wave-length λ and is observed as of wave-length $\lambda + d\lambda$. As a consequence of this relation, it is shown that the apparent photographic magnitude of a nebula is increased by dm, where dm is equal to $3d\lambda/\lambda$. If, in addition, the red-shift is interpreted as a velocity-displacement, the value of dm is increased to $4d\lambda/\lambda$. Making these corrections in succession to the observed photographic magnitudes of nine clusters of nebulæ, Hubble arrived at the formulæ (1) and (2) with evaluations of the coefficients a, b and c. The feature of (2) which we notice is that the coefficient c is found to be positive. This implies that the 'age of the universe' is considerably smaller than that derivable from the linear law (1). From the numerical value of c, Hubble suggests that the maximum permissible span is about 1,500 million years, and that the true value may be anywhere between this maximum and half of it, that is to say, less than the age of the earth as determined from geological and other considerations.

In the concluding lecture, Hubble examines the distribution of the nebulæ in space, the basis of the investigation being five great surveys of some 100,000 nebulæ, two made with the 100-in. telescope, two with the 60-in. (both Mount Wilson instruments), and the fifth with the Lick 36-in. reflector; the limiting magnitudes of the surveys range between 18·1 and 20·3, and the limiting distances between 150 and 400 million light-years. On the assumption of uniform distribution, the correction dm to be applied to the observed magnitudes is found to be $2{\cdot}94\ d\lambda/\lambda$, in almost exact agreement with the energy correction of $3d\lambda/\lambda$ mentioned above. If the red-shifts had been true velocity-displacements, the procedure should have produced a correction $4d\lambda/\lambda$.

An interpolation may be made here. Recently, Sir Arthur Eddington directed attention to the fact that Dr. Hubble had omitted to take into consideration the dispersion of the absolute magnitudes of the nebulæ in his statistical investigations (*Mon. Not. Roy. Astro. Soc.*, **97**, 156; 1937); however, Eddington's amended value of the correction, $3{\cdot}06\ d\lambda/\lambda$, is substantially the same as Hubble's value quoted above. But he also points out that in view of the accidental errors involved in the estimation of magnitudes, the numerical coefficient of $d\lambda/\lambda$ has a large probable error and should read: $3{\cdot}06 \pm 0{\cdot}56$, "so that the difference from the expected value 4·0 (that is, on the assumption that the red-shifts are velocity-displacements) is scarcely sufficient to constitute a discordance".

Relativistic cosmology has identified red-shifts with velocity displacements and incorporated them into the scheme of the universe. But Dr. Hubble, with the instinct of the observer, believes that the problem of the interpretation of the red-shifts is yet to be solved. In his last sentence he writes: "We seem to face, as once before in the days of Copernicus, a choice between a small, finite" (and expanding) "universe, and a universe indefinitely large plus a new principle of nature."

It remains to add that Dr. Hubble's book is a fascinating study of a fascinating subject, written in a style that many scientific authors would fain achieve and with an authority that must inevitably influence astronomical thought and outlook in the years ahead.

W. M. Smart.

Studies in Human Behaviour

(1) Psychology of Personality
By Prof. Ross Stagner. (McGraw-Hill Publications in Psychology.) Pp. xi + 465. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 21*s*.

(2) Factors determining Human Behavior
(Harvard Tercentenary Publications, 1.) Pp. viii + 168. (Cambridge, Mass.: Harvard University Press; London: Oxford University Press, 1937.) 10*s*. 6*d*. net.

(3) May the Twelfth Mass Observation Day Surveys 1937
By over two hundred Observers. Edited by Humphrey Jennings, Charles Madge and T. O. Beachcroft, Julian Blackburn, William Empson, Stuart Legg, Kathleen Raine. Pp. xv + 431. (London: Faber and Faber, Ltd., 1937.) 12*s*. 6*d*. net.

THE three books considered in this review, though differing considerably in their content, emphasize collectively the importance of the study of the social background of personality.

(1) Prof. Stagner's work begins in an atmosphere typical of academic psychology. He tells us that he has deliberately avoided, wherever possible, any reference to abnormal personalities, and that the book is a response to a student demand for a general text-book on 'normal' personality. The first thirteen chapters have been carefully designed in keeping with this policy, and consist largely of a résumé of some of the most important laboratory investigations in this field. This first section seems to be the weakest of the whole work, but nevertheless it should be of value to the student who wishes to find under one cover the best known experiments, theories and speculations. As a text-book, this part of the work has been well planned, and each chapter is followed by a summary and suggestions for further reading.

The second and more important part of the work, the last two hundred pages, is mainly concerned with social determinants of personality, and much of the material is drawn from the field of psychopathology. Many interesting and little-known investigations are brought together with the purpose of throwing light on various problems, such as the effect of unemployment on personality, the design of text-books for schools and their importance in the building of social attitudes and prejudices, and many other interesting and important matters.

(2) "Factors in Human Behavior"—a Harvard Tercentenary Publication—is a joint effort by eight men of science to define the forces determining human conduct. The authors are Profs. E. D. Adrian, J. B. Collip, J. Piaget, C. G. Jung, P. Janet, R. Carnap, A. L. Lowell and B. Malinowski. The value of the volume, apart from the intrinsic interest of each chapter, lies in the cross-illumination produced by the distinct viewpoints upon the central theme, each chapter discussing the problem from a different angle.

Not all the essays are of equal size or merit. First in order of magnitude and brilliance comes Prof. Malinowski's chapter. He disposes of current doctrines of mystical *Kulturgeist* and exposes the pseudo-metaphysical absolutisms masquerading as scientific anthropology. He emphasizes particularly the necessity for a strictly deterministic, functional approach to the study of cultural differences.

Prof. Collip gives us the latest results of endocrinological research. Prof. Janet expounds the interesting implications of his theory of psychological strength and weakness. Prof. Carnap reveals gaps and links between reason and unreason. Prof. Adrian gives a brief prognosis of neurological research. From Dr. Jung we get rather an operculative chapter in accordance with his well-known views, while Prof. Lowell brings a specially interesting example from British history showing the natural orderly growth of legislative integration.

All in all, this volume is an excellent instance of what scientific workers can achieve when they consent to attack the same problem from their own special points of view.

(3) "May the Twelfth", edited by Humphrey Jennings and Charles Madge, is the first of a series of 'mass observation' day surveys. The book is divided into two parts. The first part, which is the larger of the two, deals with Coronation Day and the events leading up to it. The second part deals with the general work of mass observation, of which the first part is a specific example.

The reports of the observers are given, but no generalizations are deduced from them. Throughout, one is favourably impressed with the manner of reporting events without excessive subjective bias. It would seem that even people with programmes for reforming society can be brought to distinguish between their own feelings on one hand and the objective events to be described on the other. Nevertheless, it must be clearly borne in mind that the observer will only record that

which he thinks worth recording. Owing to this process of selection, any deductions based on the difference between the number of favourable and unfavourable comments recorded can have no meaning except in so far as they throw light on the reporters themselves.

The book as a whole is very readable. Criticisms of this particular approach to sociology cannot be made until it is seen how the observations are going to be interpreted. Many readers will await with interest, and perhaps some mystification, the further publications of this series.

A Jungle Tribe of Malaya

The Negritos of Malaya
By Ivor H. N. Evans. Pp. xiii + 323 + 54 plates. (Cambridge: At the University Press, 1937.) 25*s*. net.

OF the three jungle peoples of the Malay Peninsula, Jakun, Sakai and Semang, the last-named are probably the best known to the outside world. As a racial group of low stature and negroid appearance, they form a link in the chain of pygmy and pygmoid peoples extending with intermissions from West Africa to New Guinea, their nearest affinities in south-eastern Asia being the Andaman Islanders and the Aetas of the Philippines.

The distinctive physical characters and primitive culture of the Semang, as well as the question of their place in racial taxonomy, have offered a strong attraction for the interest of the anthropologist; but their reserved and elusive temperament has rendered investigation difficult. The most considerable record among those of earlier observers is that of Vaughan Stevens, a collector working in the Malay Peninsula in the nineteenth century on behalf of a syndicate of German anthropologists. Either his good fortune in his informants and his insight into Semang beliefs were exceptional, or his capacity for invention was above the ordinary. Be that as it may, the efforts of subsequent investigators, W. W. Skeat, Nelson Annandale and H. C. Robinson, Father P. Schebesta and Mr. Evans himself have been taken up to a considerable degree, either avowedly or by implication, in checking his remarkable statements—in most instances with but indifferent success.

Of investigators subsequent to Vaughan Stevens, Mr. Evans has by far the most extensive acquaintance with the Semang, or Negritos as he, more accurately and comprehensively, prefers to call them. He has been in touch with them at intervals over the whole of the twenty years of his official connexion with the Peninsula, and he has revisited them since his retirement in 1932. It is interesting to note that he is able to go further than any of his predecessors in accepting the statements of Vaughan Stevens as verified; but this does not apply to the more remarkable of the data referring to the magical meanings said by Vaughan Stevens to be attached by the Semang to the *motifs* of their decorative art. The fact that some magical meaning is attached to their decorative designs is not, of course, in dispute.

It may appear that too much stress is laid on the question of Vaughan Stevens's credibility. That question, however, is fundamental; and all the more in Mr. Evans's work, because in presenting what is evidently intended to be a definite account of the Negritos—and it is scarcely probable at this late date that much of value will be added—he has made Skeat and Blagdon's monumental "Pagan Races of the Malay Peninsula", in which in relation to the Semang the critique of Vaughan Stevens is an important element, his starting-point. To this he has added a digest of the work of subsequent investigators, extending and criticizing it in the light of the observations which he himself has made. This applies more particularly to the material culture and the involved and complex religious beliefs of the Negritos, to knowledge of which Mr. Evans has made notable contributions; but for linguistics and physical anthropology he has to rely mainly on Dr. O. C. Blagdon's masterly study of the languages of the Peninsula, and for physical characters on Lebzelter's analysis of the data collected by Schebesta, which is the most considerable body of material extant.

The Negritos are now said to number a little less than two thousand. They undoubtedly have been subjected to much racial admixture. They are very variable in physical character, unlike the Andamanese, who are strikingly uniform. Being a lowland and river valley people, they have been much in contact with the Malays, in relation to whom their present condition is described as "servile".

Mr. Evans describes the very primitive material culture of the Negritos in detail. It is interesting to note that the bow, the characteristic weapon of this people, has been superseded almost completely by the Sakai blow-pipe, and indeed among some of the Negrito tribes it has been entirely forgotten.

In elucidating the obscure religious beliefs, with the extensive system of divine beings, Mr. Evans arrives at the conclusion that these are ancestors; but he makes the interesting and instructive suggestion that the explanation given of the origin of these divine beings—that they were the individuals who escaped to heaven and became deities because their hair had not been frizzed in the battle between the monkeys—may be derived from the Ramayana. Attention may be directed also to his remarkable and fortunate record of the shaman in action, an interesting and important matter on which little or nothing in detail was known previously. Mr. Evans was the first European to be present at a shamanistic performance and the first to describe the shaman's hut.

On the broader question of the ethnological position of the Negritos, Mr. Evans has little to add to what has been said by others. From his archæological investigations, however, he makes one important contribution. In relation to the question whether the pygmy people represent the earliest entrants into the Peninsula, he points out that the skeletal remains of the inhabitants of the caves belonging to the palæolithic-neolithic transition period investigated by him were not those of a Negrito type, and that this type does not appear until relatively late in the archæological succession.

Culture-Contact in India

A Tribe in Transition: a Study in Culture Pattern. By Dr. D. N. Majumdar. Pp. xi + 216 + 5 plates. (Calcutta, London, New York and Toronto: Longmans, Green and Co., Ltd., 1937.) 10*s*. 6*d*. net.

DR. MAJUMDAR'S book aims at doing something more than merely giving us an account of the Hos of the Kolhan. This indeed he does not neglect, but his particular purpose is to show them as they have reacted and continue to react to the effects of contacts with their Hindu neighbours. He states as his methodological ideal a synthesis of Malinowski's approach in "The Argonauts" with that of Ruth Benedict in "Patterns of Culture", but his adherence to their methods is by no means overstressed. He gives a comprehensive account of the social culture of the Ho, who clearly retain a very great deal of their typical culture in spite of their many contacts with Hinduism, which have influenced in particular their marriage ceremonies and festivals.

Dr. Majumdar seems inclined to accept the view that the Ho originally migrated southwards from the Himalayas. He mentions that the language used in spells is non-Austric, but does not specify what language actually is used. Vestiges of totemism seem to exist, though repudiated as such by the author, and there has clearly been a megalithic cult, now so generally decadent that menhirs do not seem to be erected at all, though horizontal slabs of stone are still provided for the dead.

The institution of bachelors' dormitories is considered as definitely fostering homosexuality, and this is remarkable, since generally speaking the bachelors' dormitory system, both in Assam and in Chota Nagpur, does not seem to have that effect at all. One's confidence in the author is rather severely shaken by finding that he imputes the custom of marriage by capture to the Naga Hills, and he is surely wrong in supposing that the claim on the part of a married woman's patrilineal family to the half of her bones is something new, unless it is in their not demanding the whole. The custom of returning the woman's bones to her own clan is the more ancient, and in a Munda marriage there is always a formal stipulation by the bride's clan that the bones shall be returned, although it is not really intended by either party that the promise to do so shall be implemented; in Assam a 'bone-price' is paid as a quittance for the obligation to return them.

Zoological references are obscure and the Latin names unfamiliar: the corsac fox is surely not the one usually found in India, which is more familiar as *Vulpes bengalensis* than as *Cynalopex insectivorus*; the sambar (referred to as "saumer") is generally classified as *Rusa*, not as *Cervus* by genus, and one is left guessing what is meant by "grower" and by "red deer". A map is very badly needed, and likewise a glossary to explain to the English reader such words as *birdiring*, *ficca*, *sonta* or *hatu*. Material culture is poorly treated; tattooing is mentioned, but pigments and processes are not described; and with no illustrations to help one the descriptions of objects (for example, of a plough on p. 6) are very difficult indeed to follow. On the whole, however, the book is an important contribution to Indian ethnography, particularly in its estimate of the impact of Hinduism on the culture of the Hos, and marks a rather new departure in Indian ethnographical literature.

J. H. H.

Hunting by Scent

The Mystery of Scent

By Hugh B. C. Pollard. Pp. xix + 139. (London: Eyre and Spottiswoode, Ltd., 1937.) 10*s*. 6*d*. net.

THE vagrant nature of odours would seem to be symbolized by a word-errant in search of a meaning. Scent, for example, according to a dictionary, signifies "odoriferous particles, odour, smell, fragrance; a class or one of a class of sweet-smelling, aromatic substances used for perfuming; sense of smell; odour left by the animal on the ground or surface passed over". It is the latter meaning that is mainly implied in the title of Major Pollard's book. He discusses principally the relatively complex conditions which control the diffusion of scent, and has worked out a simple instrument which will tell the hunting man the chance of scent on any day.

It is claimed to be a practical book for fox-hunting people rather than a scientific discourse. However, a racy style does not altogether mask the large quantum of science lurking in its pages ready to engage the attention of the reader and to exact his interest. The expert in ballistics proves himself to be also an adept in firing data and problems, physical, chemical and biological.

The correlation between scenting and meteorological conditions was discussed from different points of view in "Hunting by Scent" by Mr. Budgett (NATURE, **133**, 548–549; 1934), and in a pamphlet on "Scent and the Weather" by Flight-Lieut. Veryard (NATURE, **136**, 60; 1935). Major Pollard explains the development of a relatively large volume of scent from the small amount secreted by the pad glands of the fox, by suggesting that fox scent is an extremely volatile compound with marked capacity for spreading on water as a monolayer and being dissipated on water vapour. There are good reasons for doubting that the foxy (fur or bedding) scent we know is what hounds really hunt. The true 'scent' or pad secretion at each footstep is small, but on a still day the emanation from a series of pad marks was observed to form a band 15–20 yards broad, and, on a windy day, hounds are able to pick up a line even on a broader front.

The best scenting conditions prevail when the evaporation near the surface of the ground is at its maximum. The range and variation of the meteorological factors on a normal hunting day are much wider than is usually realized. No one factor alone controls scenting. The 'Pollard scentometer' (Prov. Pat. No. 26346), which is now marketed by the publishers, raises the prediction of hunting conditions in the course of the day from intelligent guesswork to a reasonable degree of fore-knowledge. The instrument comprises a thermometer, hygrometer, and an arrangement of five circular concentric dials which are set to the temperature, degree of humidity, relative amount of cloud, quarter of the wind, and wind velocity. The lower part of each dial is provided with numerical values for scent, which are read between two parallel wires and added up from the bottom to the centre. The sum represents the percentage of scent to be expected within the next few hours.

Major Pollard has also much of interest to relate about scent in other animals, about scent and local conditions, and a number of other problems, new and old, and all discussed in a stimulating manner. His book should certainly stimulate further research on such problems as that of adsorption and on the electrical phenomena in odorous vapours, and also the comparative study of the role of pigments in the olfactory mucous membrane and cognate subjects. J. H. K.

Plant Physiology for Students

General Plant Physiology

By E. C. Barton-Wright. Pp. 539. (Williams and Norgate, Ltd.) 15*s*. net.

PLANT physiology—especially the teaching of it—has not been in a satisfactory state for decades, and though one is constantly looking for signs of improvement, prospects are not reassuring. It seems worthy of reflexion that the first-class plant physiologist of the future must be the almost exclusive enthusiast of the present; for few ordinarily promising students are being attracted to the subject.

Until recently, one of the apparent reasons for this was the dearth, in fact, absence, of text-book reading for elementary students. There were no British text-books of university first degree standard, and the few American books, though worthy, seemed quite unknown. Students were

forced to depend on their lecture notes (hence on the educative powers of their teachers) and on the out-of-date English translations from well-known German texts. Now, this reason has gone, for during the past three years three text-books of the required standard by British botanists have appeared.

Two have already been favourably reviewed in these columns, and now the third, by Dr. Barton-Wright, can be received with equal favour; but only as a text-book satisfying the courses prescribed for first degrees in the universities. It is, as the author claims, "meant as a general survey of plant physiology". After having read the text, one agrees with this claim, yet with a feeling of misgiving as to the necessity for such a book. The other two text-books were surveys of the subject made by well-known authorities; in a third book appearing so soon after, one is justified in looking for a distinctive feature or features. It was with disappointment that we finished reading this survey, for no such distinctiveness could be found. From the student's point of view, however, it has the advantage of a comparatively modest price.

The book reviews the science of plant physiology very thoroughly, but, like the others, seems to be a morass of fact and theory, very loosely bound together, with little sifting or evaluation. Merely to state all relevant facts and to quote the most discussed theories, is, of course, a safe policy for the author. But what about the student? He is not reading a monograph, but rather feeling his way, and needs a hint now and then to avoid blind alleys. It is a pity that the academic plant physiologist does not seem to realize this. It is true that Barton-Wright has made a choice of matter here and there; but the choice is the same as has always been made hitherto. Theories of transpiration are considered, for example, in the usual way—mentioning, dismissing, mentioning, dismissing and culminating in a detailed consideration of Dixon's cohesion theory. It will be interesting to see how this topic will be treated in the next text-book in view of the work of Dr. P. R. White of the Rockefeller Institute for Medical Research, which has recently been recognized by the thousand-dollar prize of the American Association for the Advancement of Science. It will indeed be refreshing if White's work only causes a slight modification of the treatment of this subject.

These remarks are not directed against the book under notice specifically, except in so far as the author has allowed himself to be fettered by tradition. Indeed, at times, he does take a point of view, and talks to his readers instead of merely presenting a critical résumé of work done and theories propounded. Nevertheless, many physiologists would not agree that the "ultimate goal [of physiology] is to explain them [living processes] in terms of physics and chemistry". The statement is dangerously narrow to make to a young student. Also, whether the late Sir J. C. Bose was the head of a school of investigators which holds vitalistic views is a moot point. Bose's main theses were that response in the plant organism is identical with that of animal muscle and nerve, and that much in the living world finds its counterpart in the inorganic; this is not the same thing.

Barton-Wright is very thorough in his survey of the literature; in fact, all his publications have shown this characteristic, so that students may be sure that in following his text they are missing little of importance so far as reading for a degree is concerned. The book is good value for the money.

South African Earthworms

A Monograph of the Acanthodriline Earthworms of South Africa

By Dr. Grace Evelyn Pickford. Pp. 612. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 25*s*. net.

IT has been frequently pointed out that the advancement of systematic zoology is best served, in the present state of the science, not so much by the description of new species as by the revision and putting in order of the species that are supposed to be already known. Of the kind of work that is most needed, an excellent example is provided by this monograph by Dr. Grace Pickford. The laborious investigation of the very large collections made in South Africa by the author and by others seems to have been done with great thoroughness and care. The results are set forth in very clear fashion and—so far as a non-specialist may see—with sound judgment.

A volume of more than six hundred pages may seem a liberal allowance of space in which to deal with a single sub-family from a single geographical region, but, as is pointed out in the preface, there are very solid reasons for giving special attention to this particular group in this particular area. The Acanthodriline represent the most ancient element in the earthworm fauna of South Africa,

and their relations to the faunas of other regions in the southern hemisphere present important problems which have not yet, perhaps, been completely solved. Further, as the late Dr. Michaelsen pointed out long ago, they have, in South Africa, become differentiated into a large number of local forms, often with very restricted ranges.

In the present volume, 85 species and 44 sub-species and races are recognized. The delimitation of the areas inhabited by these and their relation to the phylogeny of the group and to the geographical and climatic changes in the recent geological history of South Africa are discussed in a series of chapters of great interest.

A mild protest may be recorded against some of the terminology used in this volume. It is doubtful if much is gained in brevity or in clarity by the use of such words as "speciation", "subspeciation" and "raciation". The printing is not above criticism, and surely the printers' reader ought to have known how to spell "desiccation".

W. T. C.

A New Continent

Soviet Geography: the New Industrial and Economic Distributions of the U.S.S.R. By N. Mikhaylov. Translated from the Russian by Natalie Rothstein. Second edition revised by the author. Pp. xviii + 229. (London: Methuen and Co., Ltd., 1937.) 10*s.* 6*d.* net.

IN a foreword to this book, Sir Halford Mackinder describes it as "a political pamphlet of the indirect order". There is not much indirectness in its politics for scarcely a page omits to contrast the blessings of the Soviet régime with the backwardness of old Russia. The tables of figures, plentifully supplied, include, as if they were facts, the estimates of the second 'plan', and the reader is asked to believe that "the industry of the U.S.S.R. . . . works according to plan, and knows nothing of crises".

But when one has discounted the propaganda, there remains in this work enough of fact to arrest attention. M. Mikhaylov claims that the Soviet Government has discovered a new continent, and this is not far from the truth. Further, it is exploiting that new land as rapidly as it can profitably do so. New industrial centres have been set up, as for example in the southern Urals, with its new towns of Magnitogorsk and Khalilovo, or in the Kuznetzk basin of west Siberia. Old industries, such as the iron industry in Leningrad and the textile industry of Moscow, which formerly depended largely upon imported raw materials, are now drawing their supplies from within the Union. Irrigation works have been extended, and crops suitable for dry areas have been introduced where irrigation is not possible. Agriculture is being revolutionized through collectivization. "The fierce resistance of capitalist elements in the villages was overcome" and the "agricultural machines", the "organization of the sovkhozes" (large-scale State agricultural enterprises), and the financial support of the Government are completing the process. It is unnecessary to continue the catalogue of development. M. Mikhaylov sets it out with an insistence and a dogmatism that make the reader wonder if it is all as nice and as satisfactory as it is pictured. Between 1913 and 1934 the "individual peasants" were reduced from 65·1 per cent of the population to 22·5 per cent and the bourgeoisie and the Kulaks have been nearly eliminated. On the other hand, the numbers of industrial workers have been doubled. This process is inevitable if one accepts the author's dictum that "the development of backward agriculture and the general industrial development of the country could not be achieved on the basis of petty individual peasant farming".

Here is the clue to the new 'Soviet geography'. To a land of boundless resources is being applied a plan of exploitation which is none the less ruthless because it is scientific. Russia as it was known in 1913 is moving eastward and northward into desert, and forest and tundra; railways, aeroplanes and ice-breakers are helping the process. How much—and relatively how little—has been done is revealed by the map showing the distribution of population. But, as M. Mikhaylov says, "the new geography of the U.S.S.R. . . . is not a spontaneous development but the accomplishment of a plan". The million people now living in the north-east quarter may some day approach more closely in number to the eleven millions in the Moscow province or the thirty-one millions in the Ukraine; but for all his assurance one can legitimately doubt if even M. Mikhaylov really believes that their lot will be one of "abundance and happiness".

J. N. L. B.

Industrial Catalysis

Catalytic Processes in Applied Chemistry

By Prof. T. P. Hilditch and Dr. C. C. Hall. (Monographs on Applied Chemistry, Vol. 2.) Second edition. Pp. xxii + 478. (London: Chapman and Hall, Ltd., 1937.) 25*s*. net.

THE subject of industrial catalysis continues to develop rapidly; such processes are the rule rather than the exception. There is a vast literature dealing with them and a rapid increase in the number of special books relating to particular aspects of catalysis. It is all the more valuable, therefore, to have a more general treatise brought up to date, especially as the new edition is characterized by the same clarity of expression as the former.

Notable examples of new catalytic processes are those involving polymerization, for example, the production of petrol and even of lubricating oils from the small hydrocarbon molecules in 'cracked' gases; or those in which the higher fatty alcohols are made from the fats by high-pressure hydrogenation in presence of copper-chromium catalysts. This group of substances, previously largely unknown, is the basis of a new class of detergents.

The subject is so intricate that it has been found necessary to introduce classified lists of processes, products and catalysts, with page references at the beginning of the book.

The chemist is acquiring remarkable powers; with the aid of a variety of catalysts and variations in temperature and pressure, he is able, for example, to produce from the one raw material, water gas, either methane, pure methyl alcohol, higher alcohols, acetic acid or petrol hydrocarbons in a range extending from butane to waxes, and to vary the proportion of these; other catalysts enable him to remove the sulphur compounds from water or town's gas or the carbon monoxide from hydrogen. A single catalyst—copper—may be used for half a dozen different reactions under different conditions.

It is about a hundred years (1835) since catalytic changes were first so called by Berzelius, and about sixty years (1875) since Squire and Messel began to make sulphuric acid at Silvertown by the catalytic action of finely divided platinum. The Norman process of fat hardening was made a practical one by the firm of Crosfield's, at Warrington, about 1910—much the same time as the Haber-Bosch process for synthetic ammonia.

Since those days, there has been a spate of catalytic processes. Prof. Hilditch has worked in the industry, published important researches and taught the subject; so he has triple qualifications for providing an up-to-date work on it.

Primes and Factors

Factor Tables giving the Complete Decomposition into Prime Factors of all Numbers up to 256,000

By Dr. George Kaván. Pp. xii + 514. (London: Macmillan and Co., Ltd., 1937.) 42*s*. net.

DR. GEORGE KAVÁN was born at Prague in 1877. His parents were Francis Kaván, a musical conductor and a composer of merit, and his wife Miroslava, an ardent supporter of the civil rights of women. After studying mathematics, physics and astronomy, Kaván became in 1900 chief assistant at the Astronomical Institute of the Czech University at Prague, where he remained until his appointment in 1919 as director of the Observatory at Stará Dala. The Observatory being at that time not fully equipped with instruments, it was found possible to use part of the publication funds to cover the cost of printing the present handsome volume of tables. The calculation was started in 1917, and after the author's death in 1933 his wife, Madame Kavánová, undertook the reading and correction of the final proofs.

The work is preceded by a preface in English by Dr. Sternbeck of Stará Dala, an introduction by Dr. A. Beer, now of the University of London Observatory, a preface in Latin by Prof. K. Petr, and a foreword in Czech by Kaván himself explaining his reasons for making the present table, and another of Euler's function $\varphi(n)$ which gives the number of integers less than n and prime to it. The greater part of this latter is already in type and should be published shortly. It appears that Kaván was largely influenced by Cayley's expression, in the British Association Reports, of the need for these tables. Cayley, for example, makes the point that in the theory of numbers the decomposition of $p-1$ where p is prime is frequently required.

Given an integral number less than 256,000, this book gives *immediate* information as to its

prime or composite character and, if composite, its complete resolution into prime factors. The emphasis is here essentially on the adjective "immediate", for tables (by D. N. Lehmer) are available giving the smallest prime factor of every integer, less than 10,017,000, which is not divisible by 2, 3, 5, and so allowing the factorization of any integer up to this limit. But the labour of producing the factors may still be very great, so much so indeed that the British Association Tables Committee issued in 1935 a table of complete decompositions of all integers less than 100,000, which was then the longest list of decompositions of consecutive integers. Kaván's work is more than two and a half times as extensive.

The tables are arranged to read horizontally from left to right across the page. The leading figures are found in the left-hand column, the terminal digit 0, 1, . . . , 9 being across the top of the page. This was the arrangement suggested by Cayley, and seems easier of reference than the Chinese method of vertical columns read downwards which has also been used in this type of table. In such tables the tabular value is only another aspect of the argument; we have in fact a table of x with x as argument. The printing is clear, and a bold clarendon type distinguishes the prime numbers; a captious critic might suggest that figures with heads and tails would have been even more appropriate for the tabular values.

The method of calculation is described in Dr. Beer's preface, and, what is more important from the user's point of view, the precautions which have been taken to ensure the greatest possible accuracy. All the decompositions were checked by re-multiplication. The decompositions were compared with those in the tables of Inghirami (1832), of Goldberg (1862), and of Chernac (1811). After printing, a last check was made by comparing the decompositions of all numbers x with those of $2x$, $3x$, $5x$. Those numbers which evaded this check were again compared with Chernac's values.

The table was used by Kaván as a basis to calculate the function $\varphi(n)$ mentioned above, in the course of which errors in the table would have been revealed. A list of 24 errors is given at the end of the book, together with a version of certain entries where the type impression is poor. It is therefore reasonable to suppose that the work will contain few, if any, undetected errors.

All those responsible may be congratulated on a fine piece of work, nobly conceived, ably executed and worthily printed.

L. M. Milne-Thomson.

Developments in Theories of Integration

Modern Theories of Integration
By H. Kestelman. Pp. viii + 252. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 17*s.* 6*d.* net.

THE author of this book complains that while Lebesgue integration is everywhere firmly established as an essential part of the theory of functions, its treatment in English text-books "remains unsatisfactory and uninfluenced by the simplified treatment of Carathéodory". The account of the Lebesgue integral he gives follows closely the lines of Carathéodory's "Vorlesungen über reelle Funktionen". The Lebesgue theory of measure forms the basis of a theory of integration from which the principal defects of the Riemann theory are absent. The Lebesgue integral is a generalization of the Riemann integral, and the Lebesgue theory of measure allows an enormous extension of the solution of the problem of areas only partially solved by the Riemann integral (or by the theory of Jordan content).

The author devotes a chapter to Riemann integration in order both to establish conditions in which it exists and to discuss its relation to problems such as the integration of derivatives and of limit functions in general. It is only by appreciating the circumstances in which the Cauchy-Riemann integral is insufficient that Lebesgue's achievement can be appreciated.

The extensions of the Lebesgue integral are traced from Hölder's definition to that of Denjoy; and the general Denjoy integral is developed without the use of transfinite numbers. This treatment is derived by the author from a paper by P. Romanovski. A chapter on Fourier series illustrates the application of Lebesgue theory to a branch of analysis for which it has been of the utmost importance.

The book begins with a chapter on the definitions and elementary theorems of the theory of aggregates, particularly of sets of points, and develops them so far as is necessary for an understanding of the theory of the Lebesgue integral. Here, proofs of several theorems depending on the existence of certain aggregates for which no rule of 'construction' was forthcoming, are legitimatized by the introduction of Fraenkel's axiom of selection. This axiom is specially invoked to prove that every infinite set contains a sequence of distinct points and it is often used implicitly in existence theorems.

A. v. Z.

Short Notices

Anthropology and Archæology

Chinese Fairy Tales and Folk Tales

Collected and translated by Wolfram Eberhard. Pp. xiv+304. (London: Kegan Paul and Co., Ltd., 1937.) 10*s*. 6*d*. net.

THIS collection of Chinese fairy and folk tales—'ghost', perhaps, would have been more accurate than fairy—differs from most with which the Western world is familiar in the fact that the collector has had them direct from the mouth of the people, and has eschewed the printed source. It may be doubted, however, how far the distinction is to be regarded as an essential difference, even though certain classes of story are absent. On Herr Eberhard's own showing, the Chinese folk-tale is the product of an attitude of mind towards the spirit-world, which is so far an effective element in every-day life, and not solely an attribute of children and the unsophisticated, as in Europe, that the product of the myth-making faculty can still be reported in a daily paper as a statement of fact. An example is quoted in the preface—a story of how a policeman became a city-god—which might equally well have appeared in the text.

Herr Eberhard states that he has made a very large collection of Chinese folk-tales, which will be published shortly. The present collection contains a selection only, and from the point of view of scientific study suffers from the fact that no indication is given of distribution or provenance. It must be regarded, therefore, as entertainment. The student of *motif*, however, will find much of interest. Early relations with India and the West must be held responsible for the appearance of Cinderella and the slipper, the three sons, and various forms of the task to be performed before marriage, inheritance, or other reward, especially in that in which it is familiar in the legend of Psyche. A number of other *motifs* which appear in European folk-lore will be found here but little changed in essentials, notwithstanding the Chinese setting. The "happy ever after" ending, however, is not invariable.

As literature, the collection is delightful and the translation lively and easy in style.

The Archæology of Sussex

By E. Cecil Curwen. (The County Archæologies.) Pp. xviii+338+32 plates. (London: Methuen and Co., Ltd., 1937.) 12*s*. 6*d*. net.

THE county of Sussex as a whole affords a more than fair sample of the characteristic cultures of an English lowland area; but its most famous contribution to the study of early man is unquestionably the Piltdown skull. Dr. Curwen records the circumstances of its discovery and the discussions as to its character and rank in the human line of descent which then took place; but presumably he regards later argument as a specialized matter scarcely falling within his province. In the earlier problems of prehistory, the county is also of importance for the evidence of the raised beaches of western Sussex.

In the mesolithic period, Sussex is notable for the discovery of microlithic implements so early as 1877 at Horsham. It includes within its boundaries a number of mesolithic stations on the greensand, which are especially significant as demonstrating mesolithic man's preference in the matter of sites for his occupation. This was also the first area in England to afford evidence, at Hassocks, of a mesolithic pit-dwelling.

Of other matters with which Dr. Curwen deals, attention may be directed more especially to his reconstruction of life on the downland in the neolithic period, for which evidence is afforded by flint mines, long barrows, camps and the like, and his admirable account of the late bronze age material, more especially the Plumpton Plain A site, where there appears the earliest known example in Britain of the introduction of the Celtic system of agriculture.

The volume concludes with a survey of Roman Sussex; the Anglo-Sussex period and the gazetteer, which have appeared in previous volumes, are omitted.

Astronomy

Sunspots and their Effects

By Harlan True Stetson. Pp. xv+201. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 8*s*. 6*d*.

THE whole life of the earth depends on the sun, and it follows that variations of solar activity should be reflected in terrestrial phenomena. In this book, Dr. Stetson gives a popular exposition of this thesis, and especially of the idea that changes in the sun associated with sunspots may have physiological or emotional effects on human beings which cause them to behave differently at times of many or few spots. This influence, if indeed it exists at all, is most probably related to the physiological action of great variations of ultra-violet radiation during the sunspot cycle, though the possibility of an electrical action is also considered. Changes of energy and confidence are reflected in various aspects of business, as shown by parallelism between economic indexes and sunspot numbers over the last few decades. The statistical basis is insufficient for proof, but the presentation is suggestive.

The author also has a good chapter on sunspots and radio, but the discussion of relations with weather and crops is brief and superficial. The second half of the book presents in a very readable way modern ideas on sunspots themselves—their causes, the migration of sunspot zones and the possible reasons for their quasi-periodic recurrence. The author is an astronomer, and for the general scientific reader this is the best part of the book.

Astronomy

By Prof. W. M. Smart. (The Pageant of Progress Series.) Pp. 158+24 plates. (London: Oxford University Press, 1937.) 3*s*. 6*d*. net.

THIS book provides an excellent summary of astronomical information which should be known by the average person interested in this science. It is written in simple and non-technical language, and will prove very readable to a large section of the public. Commencing with the earth, it extends its scope to the moon, planets, comets, meteors, the sun, and then to the extra-solar system bodies—stars, nebulæ, etc. In covering such a wide field it is inevitable that only a brief survey can be made of the various branches, but it is amazing how much up-to-date information Prof. Smart has condensed in such a small space. The book is illustrated with 24 plates and 38 diagrams, which greatly enhance its value and interest. Its modest price brings it within the reach of a large circle of readers, and we anticipate that it will be included in the category of 'best sellers.'

There are a few points to which reference might be made, though they are trivial. Dr. Jeffreys does not now believe that there is a layer of ice 16,000 miles thick on Jupiter (p. 52). It is implied that meteors move with parabolic velocity. The results of the Harvard College Arizona Expedition six years ago showed that most sporadic meteors were moving with high hyperbolic velocities, often as much as 120 miles a second (p. 75). On p. 130, line 10 from the top, the letter "C" should be substituted for "B."

M. D.

Biology

British Stem- and Leaf-Fungi (Cœlomycetes): a Contribution to our Knowledge of the Fungi Imperfecti belonging to the Sphæropsidales and the Melanconiales. By W. B. Grove. Vol 2: Sphæropsidales, comprising Sphærioideæ, with Coloured Spores; Nectrioideæ, Excipulaceæ, and Leptostromataceæ; and Melanconiales. Pp. xi+406. (Cambridge: At the University Press, 1937.) 21*s*. net.

"UNFORTUNATELY the literature of mycology consists largely of fragments, memorials of splendid designs never prosecuted, of good intentions never fulfilled. We cannot but call to mind one after another the splendid works we might have consulted had they attained completion." Thus wrote M. C. Cooke, the noted English mycologist, in 1875, and the position remains much the same to-day. With the publication of this second and final volume, however, the late Mr. Grove joined the select company of those who have completed a flora of their country's Cœlomycetes, and has become, in fact, the first to do so in the English language; it is a crowning achievement to his long career.

This final volume follows the lines laid down in the first, and finishes with three indexes and an epilogue. In the latter the author explains his aim, which has been to give a panoramic view of Saccardo's classification, in so far as it is illustrated by the British species. He has successfully accomplished this aim, and in so doing has been led into a rather severely conservative treatment of large numbers of proposed new genera; the latter may, however, be traced in the synonymy of the various species. An index of Ascomycetes that have been proved (or thought) to represent the perfect form of various Cœlomycetes is an interesting and suggestive feature, and may perhaps attract fresh workers into a fascinating field that has been so unaccountably neglected by our university students.

British mycology is indeed indebted both to the indefatigable zeal of the author in completing the work and to the Cambridge University Press, which has provided a dignified and worthy setting.

E. W. M.

Practical Zoological Illustrations

Part 1: Vertebrates. By S. Lockyer and D. R. Crofts. 28 cards, 14½ in. × 9½ in., in Portfolio. (London: Macmillan and Co., Ltd., 1937.) 10*s*. 6*d*. net.

THE types chosen for this series are those used in the junior class, namely, the dogfish (10 cards), frog (9 cards), and rabbit (7 cards). One sketch of the sheep's heart has been added. The large, clear drawings have been admirably executed by the junior author, and are based on actual dissections. They represent faithfully the relative disposition of the organs, and will therefore be helpful for beginners who find difficulty in interpreting verbal directions. Whether it is wise to train a student of pure science by this means is very doubtful. Let him rather explore the unknown, even at the risk of early failure.

The interpretation of the dissections falls somewhat short of their execution and delineation. The following structures, all of which would be visible when the dissections were made, have been omitted: the pancreatic duct (I), the buccal branch of the facial nerve (IX), the ilio-hypogastric nerve (XVIII), the corpora cavernosa (XXII), the glosso-pharyngeal nerve (XXIV), and the moderator band (XXVII). Several mistakes should be rectified. The student who looks for the internal opening of the oviduct in the frog will not find it directed mesially as on Card XIII. The seminal vesicle has been wrongly labelled on Card XIV, the coeliaco-mesenteric artery does not arise from the dorsal aorta as shown on Card XVI (see Ecker, 1896, p. 301), the rabbit's *hepatic* portal vein has been labelled *renal* portal (XXV), and in the sheep's heart the hemiazygos vein has been converted into a left superior vena cava, a vein which is lacking in the sheep, as in the majority of mammals.

Fundamentals of Bacteriology

By Dr. Martin Frobisher, Jr. Pp. ii+474+4 plates. (Philadelphia and London: W. B. Saunders Co., 1937.) 14*s*. net.

BACTERIOLOGY is no longer an exclusively medical subject. Most of the bacteria are harmless, many of them are useful, and their study is of importance to students of botany, physiology, industrial processes and agriculture. Further, from a cultural and philosophical point of view, the study

of bacteria as microscopic plants, broadens the student's interest in living organisms and deepens his appreciation of the intricacies of Nature.

It was with these considerations in mind that this volume on bacteriology has been written; the treatment of the subject is unspecialized, and its various aspects—medical, industrial, agricultural and others—are discussed on broad and general lines, and anyone adequately grounded in elementary biology may study it with profit, and, we would add, with enjoyment. The book contains a wealth of reliable and up-to-date information, comprising classification and biology, cultivation and methods of investigation, descriptions of species and their connexion with processes, with final chapters on viruses, pathogenic Protozoa and the history of bacteriology.

The book is most readable and fully illustrated with figures and plates (some coloured), including reproductions of portraits of many pioneers, and of pictures illustrating processes and the like, which add to its interest. R. T. H.

A Guide to Veterinary Parasitology:

for Veterinary Students and Practitioners. By Dr. T. Southwell and A. Kirshner. Pp. x+144. (London: H. K. Lewis and Co., Ltd., 1937.) 7*s*. 6*d*. net.

THE veterinary profession has made conspicuous progress during the last fifty years in education, usefulness, public estimation and consequent reward. No branch of the medical profession has been more quick and eager to make use of the discoveries of the age. At Onderstepoort and at Aberdeen, for example, veterinary science has great scientific institutions of its own, and this little book before us, prepared within the Liverpool School of Tropical Medicine, shows how the young veterinarians extend their experience and their education. The book needs no lengthy notice. It is a student's book, short and elementary, but lucid and sound. The pathogenic Protozoa are treated very briefly, but the introduction will serve; and the young 'vet.' who goes to South or East Africa will soon learn a great deal more. The parasitic worms are amply, though very concisely, described; and the many illustrations, which seem to be all quite new, will hold their own against those in any text-book of zoology. D. W. T.

The Fauna of British India, including Ceylon and Burma

Edited by Lieut.-Col. R. B. S. Sewell, assisted by G. Talbot. (Published under the patronage of the Secretary of State.) Moths, Vol. 5: Sphingidæ. By T. R. D. Bell and Lieut.-Col. F. B. Scott. Pp. xviii+537+15 plates. (London: Taylor and Francis, 1937.)

A NOTABLE feature in the present volume of this well-known series is the amount of information it has been possible to give on life-histories and metamorphosis. A large number of Indian Sphingidæ, or hawk-moths, have been reared by the authors, who made careful descriptions of their early stages and habits. Something is now known of the metamorphoses of 66 per cent of the Indian species and of 85 per cent of the genera. Almost all the fifteen plates are given to illustrating larvæ, or in some cases, pupæ, while the imagines are for the most part represented in the text-figures. We look forward to the time when other volumes on the moths of India can provide an equal wealth of biological data.

The taxonomy followed is that of Rothschild and Jordan's "Revision of the Sphingidæ". This work, together with later writings of these authorities, has also been extensively drawn upon in other ways in the preparation of the volume. Valuable help has also been given by Mr. W. H. T. Tams, of the British Museum (Natural History). We need only add that the authors, and others concerned in its production, are to be congratulated on the publication of a volume which should long remain the leading source of information on its subject.

A Guide to Collecting Butterflies of India

By Lieut.-Col. H. D. Peile. Pp. xiv+312+25 plates. (London: John Bale, Sons and Curnow, Ltd., 1937.) 25*s*. net.

THIS manual provides an account of those of the Indian butterflies most likely to be met with in the general course of collecting. It is intended for beginners, is of handy size and admits of easy reference. As many forms as possible are accurately figured from drawings made by the author, and notes on the habits, food-plants, etc., of numerous species are given. At the end of the book is a number of local lists of species found in various districts of India, and the nomenclature followed is mostly that used by Evans in his 1932 volume. The book should prove a useful aid for the novice, and perhaps do something towards inducing him to become something more than a collector of specimens.

More Songs of Wild Birds

By E. M. Nicholson and Ludwig Koch. (Bird-Lovers' Manuals.) Pp. viii + 104 + 29 plates. (London: H. F. and G. Witherby, Ltd., 1937.) With 3 double-sided gramophone records, 15*s*. net.

THIS little book supplements an earlier volume on "Songs of Wild Birds" noticed here a year ago (NATURE, 139, 132; 1937). Like its predecessor, it is a 'sound book'—illustrated both pictorially and by accompanying gramophone records, which are not obtainable separately. Mr. Nicholson having already given his general ideas on the subject of bird-song, the text on this occasion is largely occupied with incidental matters, such as the methods used and the difficulties experienced in securing records of birds singing in a wild state. There is also a chapter dealing with woodland, park and heath birds, including species which are not songsters in the ordinary sense. Some of the latter are recorded, and the reproduction of the curlew's cry is notably successful. The number of records has been increased from two to three, and the six sides comprise twenty-two items: the quality testifies to the skill, enterprise and patience of those responsible.

Chemistry

Laboratory Methods of Organic Chemistry

By L. Gattermann. Completely revised by Heinrich Wieland. Translated from the twenty-fourth German edition by Dr. W. McCartney. Pp. xvi + 435. (London: Macmillan and Co., Ltd., 1937.) 18*s*. net.

THAT German text-books ought to be translated into English is by no means certain; but of the value of translating a manual of practical organic chemistry there can be no doubt; for such a book is required in the earlier years of a student's life, usually before his knowledge of German is very profound.

Since its first publication in 1894, Gattermann's "Laboratory Methods of Organic Chemistry" has been the most widely used practical chemistry of the German universities, and it has been available since 1896 to English-speaking chemists in the American translation of Schober and Babasinian. Twelve years ago the book was rewritten by Wieland, and a translation by Dr. McCartney was published; since then it has again been revised, and it is this revised edition that Dr. McCartney has now translated.

The familiar lines have not been altered. After sections on general methods of manipulation and organic analysis comes the main preparative section, appropriately prefaced by two pages on the prevention of accidents. In each chapter of this section one or two preparations are first given, followed by several pages of explanation, which in turn lead on to further preparations.

This combination of theory and experiment makes the book a really excellent one for the teaching of organic chemistry. A possible criticism is that the price is rather more than most students expect to pay for a practical book; but then "Gattermann" is more than a practical book. B. K. B.

Toxicity of Industrial Organic Solvents

Summaries of Published Work compiled by Dr. Ethel Browning under the direction of the Committee on the Toxicity of Industrial Solvents. (Medical Research Council: Industrial Health Research Board. Report No. 80.) Pp. iii + 388. (London: H.M. Stationery Office, 1937.) 7*s*. 6*d*. net.

THE wide use of organic chemicals as industrial solvents has introduced certain complications, including a possible danger to health. Whilst the solvents are perfectly safe when used under proper conditions, their misuse, particularly over a continued period, may lead to trouble. There has been no definite knowledge as to which of the many compounds may be suspected before use, and thus a clear need for research into the possible effects of every material that seemed open to suspicion. The subject is receiving study at the instance of the Association of British Chemical Manufacturers and the Home Office, which have referred the medical questions to a special committee of the Medical Research Council.

As a first step, a full summary of the available literature has been prepared by Dr. Ethel Browning. It deals with the hydrocarbon group, including such familiar substances as benzol and petrol, the large class of chloro-compounds which have found wide application, the alcohols, and particularly the esters, which are becoming of increasing importance. There follow cyclohexane derivatives, ketones and glycols.

The report will undoubtedly be of interest to the large body of makers and users. A difficulty with such materials is the well-known one that, whilst the makers and large users observe the necessary precautions, small users, who often buy their materials under a proprietary name, neglect to do so.

Sterols and Related Compounds:

a Series of Three Lectures delivered at the Institute of Biochemistry, Cambridge. By Prof. E. Friedmann. Pp. ix + 100. (Cambridge: W. Heffer and Sons, Ltd., 1937.) 7*s*. 6*d*. net.

PROF. E. FRIEDMANN is a distinguished visitor in our midst, and it was possibly this fact, rather than any novel features of his lectures, that caused his Cambridge colleagues to persuade him to reprint them in book form. The subject has, after all, already been covered at various lengths by Heilbron, Windaus, Fieser, Butenandt, Lettré and Inhofer.

However, the excellent reproduction of formulæ in this book and its condensed nature help to show the close relationships of the compounds discussed, and give it a certain quality of its own. Prof. Friedmann has mastered the English language very well, and, with the assistance of Mr. T. R. Parsons, has avoided all major solecisms. There are one or two minor inaccuracies that, should a second edition of this book be required, will demand attention. On p. 50 he has confused Windaus's vitamin D_1 and the English workers' original calciferol. On p. 65 is perpetuated the statement made by Prof. Friedmann elsewhere, that vitamin D_3 contains fewer international units per gram than calciferol. Actually, the two substances, when both pure, are identical in activity, as was shown by Schenck two months before this book was published.

Nevertheless, of the physiological relationship of the steroid group, including bile acids, heart poisons, saponins, antirachitic vitamins, sex hormones and carcinogenic substances, this book remains—errors and omissions excepted—a useful and readable survey. A. L. B.

Principles of Chemical Engineering

By Prof. William H. Walker, Prof. Warren K. Lewis, Prof. William H. McAdams and Prof. Edwin R. Gilliland. (Chemical Engineering Series.) Third edition, revised and rewritten. Pp. xi + 749. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 30*s*.

THE previous edition of this book has lasted a decade, a period during which chemical engineering has expanded enormously. New processes have been discovered, old ones improved, and a great deal of more accurate information has been established.

Dr. Walker, the initiator of the book, has passed away, and Dr. Lewis has taken little part in it, so

that the work of preparing the new edition has fallen on the shoulders of the other two authors. The book has been fully revised, emphasis being placed as before on clarity in the presentation of the fundamental concepts. The most extensive changes are in the chapters on the flow of fluids and the flow of heat and on diffusional processes.

It will no doubt worthily replace the old edition on the shelves of the many who have found it of value.

Engineering

Combustion in the Boiler Furnace

By H. J. Hodsman. Second edition. (Leeds: Jowett and Sowry, Ltd., 1937.) 1*s*.

WHETHER the burning of coal in a boiler furnace shall be smoky or smokeless, or in other words, wasteful or efficient, is fundamentally a matter appertaining to the chemistry of combustion and, if the process is to be adequately understood by those employed in it, then, as a basis of rational practice, it is necessary that some effort should be made to elucidate the general principles. This has been recognized by the West Riding Regional Smoke Abatement Committee, which, as one of its activities, has established a scheme for the examination and certification of stokers and boiler attendants, for whom classes have been arranged by technical schools and colleges in the area.

The absence of suitable literature in a form and at a price to meet the needs of such students, led to the preparation of this booklet, which is issued with the approval of the Committee and has now reached a second edition embodying several alterations and additions. These deal more particularly with flue gases and the influence of their composition on efficiency, an aspect which presents some difficulty to this class of student. Beginning with an explanation of the combustion of carbon and hydrogen, in which chemical symbols and equations are freely introduced and simply interpreted, the author passes on to deal with the practical aspects of fuels and their combustion, describing from different points of view their composition and strongly emphasizing the magnitude and importance of the problem of air supply. At this point, the several methods of stoking are discussed and the influence of the character of the ash is referred to. The constitution of flue gases, the dependence of their volume and temperature upon the proportion of air supplied and the value of the carbon dioxide content are explained in straightforward terms. Their bearing on the operation and efficiency of the boiler and the practical considerations, which limit the best working proportion of carbon dioxide to a figure between 10 and 12 per cent, are set forth in terms which should readily appeal to a practically minded student.

The information presented here, in so clear and concise a form, is such as should be available in every boiler-room and in the possession of all responsible for the efficient combustion of coal, coke or other solid fuel.

Transient Electric Currents

By Prof. H. H. Skilling. (Electrical Engineering Texts.) Pp. xiii+349. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 25*s*.

THE title of this book, that of the series to which it belongs, and the first sentences of the preface, alike fail to convey a correct sense of the book's scope and aim. The preface says: "It is a book for engineers." This is only a partial truth; it is a text-book for engineering students (as indeed the preface goes on to explain), but it is not a handbook for working engineers and it is not a reference book. Much more is required before the author's hope that it "will help the student to attack any sort of transient problem with confidence" can be adequately realized. But as a text-book for students it is good; clear descriptions of the physical nature of transients take first prominence, the mathematical side being kept in its place as a necessary and important tool. Four introductory chapters are devoted to transients in simple series circuits of inductance, resistance and capacity. The next three deal with the indicial response of more complicated networks, the transient response to sinusoidal and non-sinusoidal voltages and transients in coupled resonant circuits. This last-named discussion is kept simple and illuminating by neglecting ohmic resistance. Then follows a chapter on solution of circuits with variable parameters by graphical and point-to-point methods. A clear exposition of travelling waves on non-dissipative and distortionless transmission lines leaves one to regret the serious omission of any discussion of standing-wave phenomena.

The last, and much the least satisfactory, chapter in the book gives a brief mathematical introduction to operational methods of analysis. Some faint breath of the fascination, the stimulation, the inspiration of these methods does penetrate the mathematic chill, but there is no illustration to suggest to the student the great power of these methods in the attack on otherwise difficult, laborious and intractable problems.

The book is well illustrated by figures, curves and oscillograms, and forms a good introductory text-book on the fundamental phenomena of transient electric currents.

Motion and Time Study

By Prof. Ralph M. Barnes. Pp. ix+285. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1937.) 18*s*. 6*d*. net.

THIS book by a professor of industrial engineering gives a comprehensive account of motion and time study from the days of the nineteenth century pioneers to the present day.

The large-scale development of many industrial operations during the last century has necessitated study of the most economical ways of doing the particular job, with the further object of determining the amount of work that should be done in a given period of time, and of fixing a wages scale.

The performance of manual work in an effective manner pre-supposes some understanding of the capacities and abilities of the human body. The

writer reviews the work of Taylor and Gilbreth in this connexion, and shows how much later work is indebted to these early studies. He then applies the principles to various engineering operations and shows the use of these studies for the fixing of piece rates and wage incentives.

He avoids the error of believing that there is one best way that can be imposed on all workers, and he realizes that the output is affected by other factors than the method of the workers, for example, the conditions of lighting, heating, ventilation and vibration, and that the maximum comfort of the worker must be assured.

The whole book is written in a clear and systematic way, and it should be possible for the student of industrial psychology to apply these principles to very different operations.

Engineering Mechanics:
By Prof. S. Timoshenko and Prof. D. H. Young.
Statics. Pp. xiv+334.
Dynamics. Pp. xii+323. (New York and London: McGraw-Hill Book Co., Inc., 1937.) 15*s*. each.

THESE two volumes are intended by the authors to provide a thorough course in mechanics for the non-specializing engineering student. It is scarcely necessary, as one of the authors is so experienced a teacher as Prof. Timoshenko, to state that this aim has been well achieved.

Mechanics is a subject which can be really mastered only by the solution of a number of problems, and thus these two books contain instructive problems in abundance—more than three hundred in each volume (with answers), many of which are worked out in detail while for others hints are given as to the best method of attack. It is this well-selected collection of problems which will make these books valuable to the student. But he will probably also enjoy the text itself, which carefully and in simple language, and helped by a large number of excellent illustrations, leads him to the fundamental principles and to many of their interesting applications in modern engineering problems. A. B.

Television:
Theory and Practice. By J. H. Reyner. Second and revised edition. Pp. xi+224+24 plates. (London: Chapman and Hall, Ltd., 1937.) 12*s*. 6*d*. net.

MR. REYNER'S revision of the 1934 edition has been extensive and entirely satisfactory. The television of 1937 is incomparably better than that of 1934, and this progress is fully represented in an edition in which every change has been an improvement. By discarding some descriptive matter, the author has, at the cost of some 15 per cent increase in length, and with substantial improvements in order and mode of presentation, given an up-to-date, accurate and absorbing account of present-day technique. It will appeal to a very wide range of readers, for the problem of combining accuracy, clarity and readability has been even more satisfactorily solved in this than in the excellent first edition.

Medical Studies

The Romance of Medicine
By Dr. John A. Hayward. Pp. xviii+278. (London: George Routledge and Sons, Ltd., 1937.) 6*s*. net.

THE purposes of this little work, as we learn from the preface, is "to amplify the talks and lectures that have been given for King Edward VII's Hospital Fund, in the hope that it may stimulate interest in hospital work and public health". It is also hoped that it may be useful not only to young men and women who are thinking of taking up medicine, or nursing or allied professions, but also to older persons who wish to become acquainted with preventive measures against many diseases and the means of improving national health and physique.

The book is divided into two parts, devoted respectively to pre-scientific and scientific medicine. The first part consists of three chapters, in which ancient and modern medicine are compared, and a brief account is given of the surgery, midwifery, preventive medicine and tropical diseases in early times, and the deplorable conditions prevalent in the hospitals, which were notorious for their overcrowding and high mortality. The second part, which forms the bulk of the work, contains fifteen chapters, in which an excellent account is given of vaccination against smallpox, the discovery and later developments of anæsthetics, the germ theory of disease, with special reference to Pasteur, Lister and the antiseptic system, bacteriology, tropical diseases, biochemistry, vitamins, blood transfusion, physical science and medicine, Röntgen rays, radium and nursing.

The book is written in an easy style with occasional lapses into sentimental reflections, but we have found only three important omissions which might well be made good in a subsequent edition. In view of the not inconsiderable number of children and adolescents who become infected with venereal diseases, it savours somewhat of Victorian obscurantism to have omitted this important cause of ill-health, apart from a passing reference on p. 265, while the existence of alcoholism, with the exception of its prevalence among nurses prior to the advent of Florence Nightingale, and the remarkable improvement in the prophylaxis and treatment of mental disease, are not discussed.

With these reservations, we have nothing but praise for this little book, which deserves a wide circulation. The text is liberally interspersed with portraits, microphotographs, diagrams and other illustrations.

Blood Cultures and their Significance
By Hildred M. Butler. (Monographs of the Baker Institute of Medical Research, No. 3.) Pp. xiv+327. (London: J. and A. Churchill, Ltd., 1937.) 15*s*.

A VERY complete survey of the subject of the cultivation of micro-organisms from the blood stream is given in this book. The method is one which is of considerable value as a diagnostic measure in certain diseases, and may be expected to throw light on various obscure disorders.

The history of the subject is dealt with in the first

chapter, the technique of making blood cultures in the second, and interpretation of the findings in the third. In the remaining chapters, the findings in various diseases are described, and their significance is discussed, full bibliographies being appended to each chapter and at the end of the book. It is of interest how seldom micro-organisms seem to invade the blood stream in health—so infrequently that the few positive results obtained by the author (in only four of 106 individuals examined) might well be accidental contaminations. The author, in fact, is so sure of her methods that perhaps she scarcely stresses sufficiently the need for adequate skin disinfection in the technique adopted, and the possibility of aerial contamination of the cultures made.

This book has been compiled by one who has had great experience in this field of work, and the record of her investigations here presented must prove of much value to the clinician and clinical pathologist.

R. T. H.

Complement or Alexin
By T. W. B. Osborn. Pp. xi+116. (London : Oxford University Press, 1937.) 7*s*. 6*d*. net.

COMPLEMENT or alexin, present in fresh normal blood serum, is an 'agent' by means of which delicate specific tests may be performed for the laboratory diagnosis of many diseases and for the exact determination of various bacterial species. Although in daily use in the medical laboratory, and notwithstanding much research as to what it is, its exact nature still remains somewhat of a puzzle, and it has been variously regarded as being an enzyme, a manifestation of surface energy, a physical or physico-chemical state, a colloidal phenomenon. This book contains a most useful survey of the scattered but extensive literature upon complement and its action, and since Dr. Osborn has himself contributed to its study, he has been in a position to select the more relevant matter and to evaluate its trustworthiness. A bibliography, running into eleven pages, is appended. R. T. H.

Short Manual of Regional Anatomy :
Written for the Medical Student as an Aid to a Rapid Revision of the Whole Subject. By J. A. Keen. Pp. vii+167. (London, New York and Toronto : Longmans, Green and Co., Ltd., 1937.) 5*s*. net.

THE author of this little work, who was formerly prosector and demonstrator of anatomy at King's College, London, deserves the gratitude of the student, whose labours he has done much to alleviate by his concise but lucid exposition. The English terminology adopted in 1933, in which eponymous nomenclature is omitted, is used throughout, but the older terms beloved of the medical historian are also given, and the Latin and Greek derivations, of which most students are ignorant, are appended to each chapter. The text is liberally interspersed with excellent figures and diagrams.

Appendicitis :
a Clinical Study. By W. H. Bowen. Pp. xii+202. (Cambridge : At the University Press, 1937.) 7*s*. 6*d*. net.

THIS little work, which Sir Arthur Hurst in his introduction declares to be the most satisfactory review of the subject in the English language, is based on the author's experience at Guy's Hospital and elsewhere. Special chapters are devoted to the etiology, diagnosis, prognosis, varieties of the disease, treatment and post-operative complications. A series of fifty-one cases is appended, classified in three groups according as the treatment was successful or unsuccessful, or other lesions were found at the time of the operation. The book should appeal alike to the physician, surgeon, general practitioner and senior student.

Miscellany

The Biology of Human Conflict :
an Anatomy of Behaviour, Individual and Social. By Dr. Trigant Burrow. Pp. xl+435. (New York : The Macmillan Co., 1937.) 15*s*. net.

IN this study of human behaviour the method and conditions of the inquiry upon which it is based are of no less interest and significance than the conclusions. The book is sponsored by the Lifwyn Foundation, a community formed for the purpose of this investigation at the instance, and under the inspiration, of the author. It consists of a number of individuals, male and female, socially and economically of varied but normal pursuits as ordinary citizens, who for sixteen years lived together as material for self- and communal-observation. The community was, in fact, the author's laboratory for the investigation of the fundamental causes which underlie the social maladjustments, of which insanity and criminality are among the most commonly encountered symptoms.

The point of view, or hypothesis, adopted by Dr. Burrow, which was thus submitted to examination, was based upon his previous experience of neuroses, suggesting that these and other evidences of conflict in behaviour are not abnormalities in a social environment which is predominantly sound, but indicate that the origin of the conflict is the elevation into a law of social conduct of the divorce between reality and the symbolism of the word by which reality originally was designated. The valid touchstone of behaviour is not the symbolism of the word, but the functioning of the organism as an integral whole. When, for example, the familiar dilemma of the relative character of the standards of good and evil is examined by an observer, who includes himself as material for observation and experiment, it emerges that, through symbolism, what is in fact secondary has been made the basis of judgment.

We Live and Learn :
Addresses on Education. By Sir Josiah Stamp. Pp. vii+214. (London : Macmillan and Co., Ltd., 1938.) 7*s*. 6*d*. net.

THE addresses printed in this volume cover a wide field. Consider their titles : graduation

in social judgment, the management of mind, the limits of technical education, the development of post-primary education, education and the Christian view of the world, the tyranny and liberty of books, geography and economic theory, the institution in modern society, education and awareness. At first sight these nine themes appear unconnected. They turn nevertheless upon a three-fold conception of the aims and obligations of education, namely, that it should fit us to get a living, to live a life and to mould a world. If those aims, *in that order*, be accepted (and we doubt whether the acceptance is as widespread as the author believes) the link between the addresses becomes plain.

We hope the book will be read by educationists because it contains the kind of challenge they should expect when a mind as fresh and vigorous as Sir Josiah Stamp's examines their methods and purposes. His remark that he is "tired of people who pride themselves on their *general* ability and culture who have never been through the personal discipline of accurate and fine performance in some *particular*", might well be carefully studied by those to whom the word 'culture' represents something difficult to find in our modern industrial and commercial world. We hope, too, that the book will be read by scientific workers so that they may realize the danger to their own work if they lack awareness of the work of others, and of the interdependence of all branches of learning. J. W. M.

International Institute Examinations Enquiry
A Conspectus of Examinations in Great Britain and Northern Ireland. By Sir Philip Hartog, with the assistance of Grace Roberts. Pp. xiv + 182. (London: Macmillan and Co., Ltd., 1937.) 3*s*. 6*d*. net.

THE field (or jungle) covered by this bird's-eye view includes an amazing variety of tests applicable to examinees of all ages from ten upwards. The bird in question being Sir Philip Hartog, it is scarcely necessary to say that the view is comprehensive, keen, intelligent and lucid. It comprises (*a*) the Local Education Authorities', (*b*) the secondary school, and (*c*) the university examinations; also (*d*) those conducted under statutory authority for admission to professions or callings, and (*e*) a list of examining bodies classified under general subject headings—accountancy, advertising, aeronautics. . . . As regards (*a*), (*b*) and (*c*), the subjects of examination are set forth in detail. Incidentally, some light is thrown on methods. A glance through (*a*) shows that 'intelligence tests' are widely used as well as school records and interviews. In the university section, prominence is given to the growing practice of conferring degrees either wholly or partly for a thesis.

As regards (*d*) the various procedures adopted by Parliament in conferring authority to admit to certain callings are shown in brief without detailed lists of subjects of examination. This and the other publications ("English Bibliography of Examinations", "Examination of Examinations", "Essays on Examinations", "Marks of Examiners") of the Examinations Enquiry Committee (chairman, Sir Michael Sadler; director, Sir Philip Hartog) should be most helpful to all whose business it is to see that these multitudinous sifting processes function as beneficially as may be. The committee, and parallel committees in other countries, owe their existence to the International Institute of Teachers College, Columbia University and certain Carnegie endowments.

Science and Social Welfare in the Age of Newton
By Prof. G. N. Clark. Pp. vii + 159. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 6*s*. net.

A FACTOR in the growing concern of scientific workers with the social consequences of their work has been the realization that the extent of their work is itself largely determined by the nature of the society in which they work. In this interesting little study, Prof. G. N. Clark shows us, however, that this is no new phenomenon and that scientific progress was conditioned by the state of society as truly in the age of Newton as it is to-day. In a series of chapters dealing with science and technology, economic incentives to invention, the social and economical aspect of science and the social control of technological improvement, which represent the substance of four lectures delivered in the University of London in 1936, he gives a highly suggestive survey of the way in which not only has applied science influenced the whole structure of society but also science, and scientific methods, have been shaped and sharpened by what they took over from the arts and crafts and from the practice of merchants.

Prof. Clark traces five distinct groups of influence upon science, those from economic life, from war, from medicine, from the arts and from religion, all reinforcing or clearing the way for the sixth great motive, the disinterested love of truth, which it is the special social function of the universities to liberate from the pressure of other motives. In the final chapter he surveys the position of social science and shows that already at the beginning of the eighteenth century it appeared to have an established position and a great future. His little volume appears at an opportune moment and has claims on the interest of all those scientific workers who are concerned with the increasing co-operation of science and economic life. R. B.

Philosophy and Psychology

The Human Situation:
the Gifford Lectures delivered in the University of Glasgow, 1935–1937. By W. Macneile Dixon. Pp. 438. (London: Edward Arnold and Co., 1937.) 18*s*. net.

HOWEVER difficult and technical philosophy may be to-day, its purpose is still practical: knowledge and happiness are and remain fundamental urges of man, which cannot be brushed aside by a simple pronouncement of modern science that man is completely unimportant in the economy of the world. The only way to replace philosophy in that lofty station it should occupy in our interests, is to bring it back to the market place without stripping it of

its academic dignity. This Prof. Dixon does with conspicuous success. In keeping with the intentions of the founder of the Gifford Lectures, the author discusses the evolution theory, personality, responsibility and determinism, relativity, quantum mechanics, original sin, Christianity and Buddhism, and all the major problems of thought and conduct in a 'popular' manner, by using words of daily speech in the sense to which we are all accustomed and with the purpose of being more easily followed.

The philosophical attitude of the author, which approximates that of Leibniz, makes his attempt the more sympathetic; while his co-ordination and criticism of the views held by philosophers, theologians and scientific workers, give his work an outstanding importance for our time, which suffers too much from extreme specialization.

T. G.

A Critical Exposition of the Philosophy of Leibniz: with an Appendix of Leading Passages. By Bertrand Russell. Pp. xxiii+311. (London: George Allen and Unwin, Ltd., 1937.) 12*s*. 6*d*. net.

THE philosophy of Leibniz has achieved considerable importance in recent years, on account of the growth of mathematical logic, which is considered to be a development of it. Hence the interest of Russell's critical exposition of the great philosopher's views, and the justification for this second issue of the work. Though a reprint of the first edition (1900), the present book contains a preface in which Russell takes stock of Leibnizianism and points out where his own ideas now differ from those he held nearly forty years ago. In spite of the publication, in the meantime, of a wealth of small scripts of Leibniz which necessitate a readjustment of his views on some details, Russell finds little cause for altering his original estimate of the philosophy of Leibniz—an admission which gives an added interest to the re-issue of his masterly monograph.

Visual Perception
By M. D. Vernon. Pp. xi+247. (Cambridge: At the University Press, 1937.) 15*s*. net.

THIS monograph gives for the first time in a single volume a comprehensive and detailed account of the numerous experimental investigations that have been carried out on the nature of visual perception. It has been Miss Vernon's aim in this book to present a treatment of the subject as exhaustive as possible, while avoiding preconceived bias towards one or another hypothesis, and to record the essential results that emerge from the experimental work. The development of the process of perception, the relations between percept and observer and percept and object, and the development of perception in children, are dealt with in turn, and the work of the Gestalt school of psychologists is fully considered. An appendix contains descriptions of the most generally used tachistoscopes, and references to some four hundred publications consulted in the preparation of this monograph are contained in the bibliography.

Physics

An Introduction to Modern Thermodynamical Principles
By A. R. Ubbelohde. Pp. viii+132. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 8*s*. 6*d*. net.

A SERIES of lectures delivered in the Department of Thermodynamics at Oxford forms the basis of this book. The contribution which the Clarendon Laboratory has made to chemical thermodynamics is widely known, and the author has performed a valuable service in presenting the points of view of this school in such a readable form.

Nernst's theorem was probably better understood, in its early days at least, on the Isis than on the Cam: we find an adequate account of its successes and failures, though one might hesitate to subscribe wholeheartedly to the opinion—expressed in the preface—that thermodynamics is an essentially practical science. Carathéodory in his "Grundlagen" presumably thought much needed doing before that condition could be realized. The experimentalist, however, is often in a state of partial confusion between the various thermodynamic functions and the uses to which they may be put in the study of equilibria. This volume disentangles them with exceptional lucidity, and their practical value is always before the reader.

The discussion of the specific heat of solids follows conventional lines; it might, perhaps, have been more valuable if at least a mention had been made of Schaefer's analysis, which showed that in the immediate neighbourhood of the absolute zero Debye's T^3 law cannot be valid, and that a transcendental expression is demanded. Completeness apart, this result is exceedingly interesting on its own account as an example of the application of the theory of functions to a physical problem.

The chapters dealing with statistical mechanics are very well done, and give exactly the right amount of information, with no needless elaboration.

F. I. G. R.

Thermodynamics
By Prof. Enrico Fermi. (Prentice-Hall Physics Series.) Pp. x + 160. (New York: Prentice-Hall, Inc.; London and Glasgow: Blackie and Son, Ltd., 1937.) 3 dollars; 7*s*. 6*d*. net.

PROF. FERMI'S treatise is not so specialized as might be imagined from the fact that it is a development of a course of lectures given in 1936 at the Columbia University. It is classical in outlook and quite elementary in treatment, beginning with a close consideration of the definition of a thermodynamical system, about half the book being concerned with chapters on the first and second laws of thermodynamics and entropy.

A useful chapter on thermodynamic potentials where free energy is defined as $U - TS$ and the function $U - TS + pV$ is the thermodynamic potential at constant pressure, contains a clear, if condensed, treatment of the phase rule and the

thermodynamics of the reversible cell. The two following chapters deal with gaseous reactions and with the thermodynamics of dilute solutions. The concluding chapter on the entropy constant and the Nernst theorem contains a few hints of quantum mechanical concepts.

The book is inexpensive and will form a useful addition to the shelves of the student of physics or physical chemistry. A. F.

Properties of Matter
By D. N. Shorthose. Revised edition. Pp. viii + 168. (London: William Heinemann, Ltd., 1937.) 4*s*.

THE author intends this book for higher school certificate and scholarship examinations. In the section on dynamics the general relations of mass and motion are assumed, as the book begins with a chapter on circular motion, followed by one on simple harmonic motion. It is doubtful whether the use of initials in place of the names of quantities is really an advantage. A few are, of course, well recognized, such as E.M.F. and H.P., but the use of M.I., P.E. and K.E. is questionable.

The chapter on gravitation follows the usual lines, but the fact that the attraction of a uniform sphere is the same as that of an equal mass at the centre is assumed. The chapter on surface tension is particularly good. Then follow friction and elasticity, omitting beams.

In the second edition a chapter on viscosity has been added for the sake of completeness. Throughout the book are numerous worked examples, and at the end of each chapter is a set of examples which the student will find extremely useful.

Travel

Stepping Stones from Alaska to Asia
By Isobel Wylie Hutchison. Pp. x + 246 + 20 plates. (London, Glasgow and Bombay: Blackie and Son, Ltd., 1937.) 12*s*. 6*d*. net.

THIS makes no pretensions at being a scientific compilation; it is merely "a little record of a happy summer". Nevertheless, it will delight the scientific worker with a taste for semi-adventurous travel not only because of its breezy narrative and vivid descriptions of new and noteworthy features offered by a little-known part of the world, but also because of the highly commendable (and unfortunately quite unusual) care with which the author has followed the dictates of specialists who have worked in the region concerned. This region is, primarily, the Alaskan-Aleutian Chain, which extends in graceful curve but treacherous seas nearly 2,000 miles westwards from north-west America towards Asia. Such notes as we are given on its flora and ethnology are right up to date, the theorizing being correspondingly restrained, with the result that we are presented with a record which will be of definite value to all who are interested in the life and surface features of the North Pacific.

The few small blemishes are in most cases unwarranted generalizations concerning other parts of the globe. Thus some places spoken of as being in northern Greenland are in reality far south on that great 'continent', even if their district is known to the inhabitants as "North Greenland", while the reviewer has seen Greenland (and also Baffin) Eskimo devour ravens with marvellous dispatch, and has even joined in the feast with no ill-effect or hint at a 'taboo'; he has also found *Spiranthes Romanzoffiana* growing wild in many places much nearer to the British Museum than Alaska or even Hudson Bay!

The author is an energetic Scottish woman, apparently of middle-age—an ardent and experienced, if technically untrained, botanical collector—with grit and perseverance as outstanding attributes. Now here lies a poignant indication; she has recently visited several of the least accessible regions in the world alone and without 'expedition press' or acclamation as a 'heroic explorer', which suggests once more that the epoch of such things and people is drawing to its natural close, and that its place is being taken by one of serious scientific investigation and honest travel.

N. P.

The Black Musketeers:
the Work and Adventures of a Scientist on a South Sea Island at War and at Peace. By A. J. Marshall. Pp. xiii + 329 + 35 plates. (London: William Heinemann, Ltd., 1937.) 15*s*. net.

MR. MARSHALL'S "Black Musketeers" are the Melanesian inhabitants of Espiritu Santo, the most northerly island of the New Hebrides group. The name by which he calls them is not so fanciful as it may seem. Their characteristic weapon, once the bow, is now the old Snider musket, a relic of the mid-nineteenth century.

Mr. Marshall, a young Australian, who had already won his spurs as an explorer and ornithologist on his own continent, joined Mr. Tom Harrisson, a member of the Oxford University Exploration Club's expedition to the New Hebrides. He was left behind by the expedition for a further year's observational work on the causes of a breeding season in animals and plants. The subjects of the investigation were birds, bats and lizards, of which specimens were collected for dissection at stated periods throughout the year. Meteorological observations were made and recorded daily. The routine work was certainly strenuous; but nevertheless the two colleagues had ample opportunity, as is shown in "Savage Civilisation", the book by Mr. Harrisson covering the same period, to make friendly and in some instances intimate contacts with the natives. Their most exciting adventure here recorded was an inter-village war, in which they barely escaped being involved; while a hurricane provided its share of thrills by partially wrecking their camp. Mr. Marshall is no less strong than Mr. Harrisson in his condemnation of the English-French condominium; but the work of the missionaries, however much it may have been misdirected in the past, is now accorded its meed of praise.

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New Fellows of the Royal Society of Edinburgh

AT the ordinary meeting of the Royal Society of Edinburgh, held on March 7, the following ordinary members were elected: Mr. C. H. W. G. Anderson, head master and superintendent, Royal Blind School, Edinburgh; Dr. P. Bacsich, lecturer in human embryology, University of Glasgow; Dr. D. A. Bannerman, unofficial scientific worker, Department of Zoology, British Museum (Natural History); Mr. A. W. M. Beveridge, treasurer, Bank of Scotland, Edinburgh; Dr. G. B. Brook, district veterinary officer, County Council of Staffordshire; Mr. C. A. Carlow, managing director, Fife Coal Co., Ltd.; Sir Ian Colquhoun; Prof. M. M. Cruickshank, Madras Medical College, Madras; Mr. S. Cursiter, director, National Galleries of Scotland, Edinburgh; Dr. J. M. Dewar, Edinburgh; Mr. N. McOmish Dott, neurological surgeon, Edinburgh; the Right Hon. Lord Elphinstone; Mr. C. H. P. Gifford, Edinburgh; Dr. Cecil Gordon, lecturer in genetics, University of Aberdeen; Dr. W. S. Gordon, chief bacteriologist, Moredun Institute, Animal Diseases Research Association, Gilmerton, Midlothian; Dr. R. Kumar Goyal, research worker, School of Tropical Medicine, Calcutta; Dr. J. R. C. Greenlees, head master, Loretto School, Musselburgh; Mr. G. Hogarth, chairman, Fishery Board of Scotland, Edinburgh; Mr. J. D. H. Jamieson, lecturer in dental diseases, University of Edinburgh; Dr. A. M. MacGillivray, lecturer in clinical ophthalmology, University of St. Andrews; Dr. Alexander Mackie, science master, Trinity Academy, Edinburgh; Prof. W. H. McMillan, Hood professor of mining, University of Edinburgh and professor of mining, Heriot-Watt College, Edinburgh; Prof. Donald Mainland, Department of Anatomy, Dalhousie University, Halifax, Nova Scotia; Dr. C. A. Malcolm, librarian, Signet Library, Edinburgh; Sir John Maxwell Stirling Maxwell; Prof. H. H. Monteath, Conveyancing Department, University of Edinburgh; Dr. S. S. Munro, geneticist, Dominion Department of Agriculture, Ottawa; Prof. T. C. Phemister, Department of Geology, University of Aberdeen; Dr. A. M. Ramsay, formerly lecturer in ophthalmology, University of Glasgow; the Right Hon. Earl of Rosebery, lord lieutenant of Midlothian; Mr. J. Sandilands, lecturer in chemistry, Heriot-Watt College, Edinburgh; Mr. A. H. H. Sinclair, honorary surgeon-oculist to H.M. the King in Scotland, Edinburgh; Dr. James Stewart, chief biochemist, Moredun Institute, Animal Diseases Research Association, Gilmerton, Midlothian; Mr. J. L. Stewart, director of veterinary services, Gold Coast; Dr. A. Landsborough Thomson, principal assistant secretary, Medical Research Council, London; Dr. Robert Thomson, education officer, Air Ministry, Aylesbury, Bucks.; Dr. Andrew Topping, a senior medical officer, Public Health Department, London County Council; Prof. A. E. Trueman, Department of Geology, University of Glasgow; Dr. O. J. Walker, lecturer in chemistry, University College, London; Mr. Robert Wilson, master printer, Edinburgh; Dr. G. McCreath Wyburn, lecturer in anatomy, University of Glasgow.

Announcements

THE Institute of Metals Medal "for outstanding services to non-ferrous metallurgy, whether on the practical or scientific side" was awarded to Sir William Bragg at the annual meeting of the Institute held on March 8.

THE Bessemer Gold Medal for 1938 of the Iron and Steel Institute has been awarded to Dr. C. H. Desch, superintendent of the Metallurgical Department, National Physical Laboratory, Teddington.

THE Keith Prize, for the period 1935–1937, of the Royal Society of Edinburgh has been awarded to Prof. H. S. Ruse, professor of pure and applied mathematics in University College, Southampton, for his paper "On the Geometry of Dirac's Equations and their Expression in Tensor Form" published in the *Proceedings* of the Society within the period, and for his other papers in the *Proceedings*.

AT the sixtieth annual general meeting of the Institute of Chemistry, held on March 1, Sir Robert Pickard was re-elected president. The Meldola Medal for 1937 was presented to R. P. Bell, of Balliol College, Oxford, and the Sir Edward Frankland Medal and Prize was awarded to L. Smith, of the Sir John Cass Technical Institute.

PROF. VIKTOR MÜLLER-HESS, director of the Institute for Forensic and Social Medicine in the University of Berlin, has been nominated a corresponding member of the Portuguese Academy of Sciences.

THE Associated Voluntary Hospital Board has appointed a commission under the chairmanship of Dr. Arnold D. McNair to report on the investigation and treatment of cancer in the Liverpool area, and on the possibility of extending and improving the work. Particular attention is to be paid to the best way of using and co-ordinating the available hospital and research facilities. The Commission is also to decide whether a change is needed in the organization, policy or construction of a Liverpool radium institute and hospital for cancer.

THE British Council has instituted twenty post-graduate scholarships, each of the value of £250, to enable foreigners who have graduated in their own country to pursue a year's specialized study at a British university. The scholarships have been allocated on the basis of either one or two for each of 14 countries. A wide choice of subjects is given, and include architecture, agriculture, engineering, trade, sociology, aviation, forestry, journalism, law, shipbuilding, textiles, Oriental languages, history, and English language and literature.

ERRATUM. After having been approved by the authors and finally passed for press, the block for the diagram illustrating the communication by Dr. J. B. Speakman and E. Stott in NATURE of March 5, p. 414, was unfortunately inverted. The axes of the figure are, of course, correct; but the graphs should be inverted in relation to these axes.

Letters to the Editor

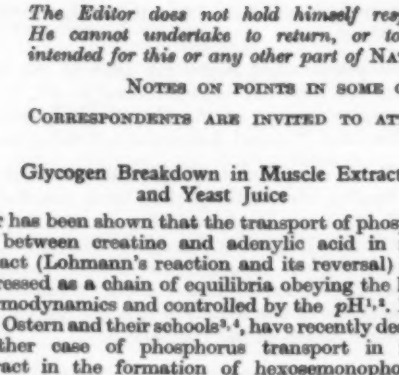
The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 476.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Glycogen Breakdown in Muscle Extract and Yeast Juice

IT has been shown that the transport of phosphorus (P) between creatine and adenylic acid in muscle extract (Lohmann's reaction and its reversal) can be expressed as a chain of equilibria obeying the laws of thermodynamics and controlled by the *p*H[1,2]. Parnas and Ostern and their schools[3,4], have recently described another case of phosphorus transport in muscle extract in the formation of hexosemonophosphate from inorganic phosphate and glycogen. It appeared of interest to study the kinetics of this reaction.



INHIBITION OF GLYCOGEN BREAKDOWN BY GLUCOSE IN MUSCLE EXTRACT. 1 C.C. OF 10 DAYS OLD MUSCLE EXTRACT (AFTER MEYERHOF) FROM RABBIT + 2 C.C. ADDITIONAL SUBSTANCES CONTAINING 10 MGM. GLYCOGEN; 1·15 MGM. P as PHOSPHATE BUFFER, *p*H 7·2; 200γ ADENYLIC ACID AS SODIUM SALT. 100 PER CENT TURNOVER WAS 0·51 MGM. P OF HEXOSEMONOPHOSPHATE FORMED.

It was first of all of interest to find that dialysed extract of yeast to which yeast adenylic acid was added behaved exactly like muscle extract; it phosphorylated only glycogen and not glucose. Willstätter and Rohdewald[5] showed that living bottom yeast condenses glucose to glycogen before phosphorylation occurs.

The reaction reaches in muscle extracts and yeast juice alike an equilibrium which may be expressed by the following equation, in which water cancels out and glycogen may be described sufficiently for this purpose as hexoseanhydride (*n* hexose $-(n-1)\,H_2O$):

$$\frac{\text{Mol. Hexosemonophosphate}}{\text{Mol. Hexoseanhydride} \times \text{Mol. Phosphate}} = K \times 10^{-3}$$

At 37° and *p*H 7·2, *K* was between 0·02 and 0·08 and of about half that value when starch was used instead of liver glycogen. Hexosemonophosphate, the product of the reaction, inhibits esterification of glycogen. Of more general interest is the observation that the glycogen breakdown can also be suppressed by glucose.

The braking effect of glucose on glycogen decomposition is 50 per cent at a concentration equal to that of the sugar level in normal blood, and nearly vanishes at a concentration corresponding to hypoglycæmia *in vivo*.

Two suggestions may be made which account for these observations with muscle extract.

(*a*) Lactic acid formation from glucose (which needs no inorganic phosphorus and has glutathione as coenzyme) may be different[6] in its physiological meaning from the lactic acid formation from glycogen (which needs phosphorus, magnesium, adenylic acid and cozymase). The former reaction, prevailing, for example, in brain (Ashford and Holmes[7]), and in the embryo (Needham and Nowinski[8]) would serve for continuous functioning and would be kept up steadily by the glucose level of the blood. The latter reaction, most pronounced in skeletal muscle, would act as a reserve and increase the lactic formation, acting discontinuously as a 'second wind' where sudden heavy demands on the blood sugar cause local hypoglycæmia.

(*b*) Secondly, the phenomenon observed may help to make intelligible the mechanism of hypoglycæmic convulsions. Sudden increase in breakdown of muscle glycogen, which is connected with muscular contraction, should occur when the blood sugar is low. These convulsions are already known to be independent of the brain as they can occur in the decapitated animal[9], where a dehydration of the blood takes place which, as Olmsted and Taylor[9] have described it, "could be due to increase in molecular concentration within the tissue itself". Excess of hexosemonophosphate, a very active oxygen acceptor, could account further on for the extreme deoxygenation observed by the same authors in hypoglycæmic blood which in the arteries was already of venous appearance. Hypoglycæmic convulsions in insulin shock depend in their intensity on the previous diet of the experimental animal, and they are much more marked after a diet rich in carbohydrate (Abderhalden and Wertheimer[10]). This should lead to glycogen storage in the tissues.

HERMANN LEHMANN.

Biochemical Laboratory,
Cambridge.
Jan. 25.

[1] Lehmann, *Biochem. Z.*, **281**, 271 (1935).
[2] Lehmann, *Biochem. Z.*, **286**, 336 (1936).
[3] Parnas and Baranowski, *C.R. Soc. Biol. Paris*, **120**, 307 (1935).
[4] Ostern, Guthke and Terrakowce, *Hoppe-Seyl. Z.*, **288**, 9 (1936).
[5] Willstätter and Rohdewald, *Hoppe-Seyl. Z.*, **247**, 269 (1937).
[6] Needham and Lehmann, *Biochem. J.*, **31**, 1210 (1937).
[7] Ashford and Holmes, *Biochem. J.*, **23**, 748 (1929).
[8] Needham and Nowinski, *Biochem. J.*, **31**, 1165 (1937).
[9] Olmsted and Taylor, *Amer. J. Physiol.*, **69**, 142 (1924).
[10] Abderhalden and Wertheimer, *Arch. ges. Physiol.*, **205**, 547 (1924).

Magnesium and Calcium Content of Hedgehog Serum during Hibernation

OUR knowledge of the mineral metabolism of hibernation is still very meagre. I have therefore investigated, among other questions, the magnesium and calcium content of hedgehog serum. Part of the animals were analysed in early October, about four to five weeks before the final onset of hibernation, and others in early January when the hibernation was at its deepest. Calcium was determined by Kramer and Tisdall's method; magnesium was precipitated as magnesium ammonium phosphate according to Rappaport[1], and the phosphorus was determined colorimetrically with a Zeiss Pulfrich-photometer according to the amidole method of Müller[2].

In autumn, before the onset of hibernation, the magnesium content of the hedgehog serum averaged 3·20 mgm. per cent. The series comprised seven animals, the magnesium content varying from 2·90 to 3·55 mgm. per cent. The calcium content of the serum of these animals averaged 10·0 mgm. per cent, with variations ranging from 9·2 to 10·6 mgm. per cent. The average ratio calcium to magnesium was 3·15.

In the beginning of January the hedgehogs were in deep hibernation. The magnesium content of the serum then averaged 5·43 mgm. per cent. The series consisted of six animals, the variations in the magnesium content being 4·90–6·05 mgm. per cent. The calcium content in the serum of these animals averaged 10·2 mgm. per cent, varying from 9·6 to 10·7 mgm. per cent. The average ratio calcium to magnesium was 1·88. It is seen that the magnesium content of the hedgehog serum has increased considerably during hibernation. In the above experiments, the magnesium value during the deepest hibernation in mid-winter was 170 per cent of the corresponding value in autumn, before the onset of sleep. On the other hand, the calcium content remains constant. This causes a decrease in the ratio.

It seems that the increase of the magnesium content of the serum during hibernation is an important phenomenon in general biology. Lustig, Ernst and Reuss[3] have recently shown that there is a considerable increase also in the magnesium content of the blood of Kursiv during winter torpor. It is known that the most striking effect of the magnesium ion is its power to produce anæsthesia. It has an anæsthetic effect on several invertebrates of sea and fresh water and, as shown already by Meltzer and Auer[4], also on vertebrates. The anæsthesia disappears if some calcium is injected into an animal previously treated with magnesium. In view of these results, it is interesting to note that, according to my determinations, there is not only an increase in the magnesium content of the serum of the hibernating hedgehog, but also a considerable change in the ratio calcium to magnesium.

PAAVO SUOMALAINEN.

Biochemical Institute,
Helsingfors.
Jan. 26.

[1] Rappaport, "Mikrochemie des Blutes" (Wien, 1935).
[2] Müller, *Z. Kinderheilkunde*, **57**, 243 (1935).
[3] Lustig, Ernst and Reuss, *Biochem. Z.*, **290**, 95 (1937).
[4] Meltzer and Auer, *Amer. J. Physiol.*, **14**, 366 (1905); **16**, 233 1906); **21**, 400 (1908).

A Contradiction in the Present Clearance-Reabsorption Views of Urea Excretion

BEYOND a certain rate of urine flow, for man, dog, rabbit, etc., and provided the blood concentration does not exceed a concentration of about 200 mgm./100 ml., the following equation holds approximately:

$$\frac{\text{Output of urea}}{\text{Blood conc.}} = \text{constant},$$

and has been chiefly demonstrated by the work of Addis and Drury[1]. The constant of this equation has been interpreted as a volume of blood per minute by Van Slyke and Peters[2] and called a 'clearance', since it has also the dimensions of a volume. The interpretation is here particularly unsafe since a much better equation applying over the whole range of urine volume gives a constant with no such dimensions (a diffusion pressure equation).

The explanation given of the constancy is that there is a constant filtration rate at the glomerulus and that variations in the urine volume excreted are almost altogether due to different volumes of water reabsorbed. Since, however, the inulin clearance is about twice that of the urea[3] and inulin is not regarded as actively excreted by tubular action, it must necessarily follow that about half the glomerular output of urea is reabsorbed in the passage through the tubules. It is this view that contains an inherent contradiction.

To demonstrate this, we may suppose that the subject (human) is excreting at a rate of 200 ml. urine per hour and at a blood urea concentration of 20 mgm./100 ml., this being achieved by water drinking. After the water diuresis has passed, urea is administered so that the blood concentration reaches 80 mgm./100 ml. and the urine rate again reaches 200 ml. per hour. There is now a general agreement that—at least within 10 per cent—the average clearance value will be the same as before. This can only mean on the above view that four times the amount of urea is being reabsorbed back across the tubule, and hence the conclusion that urea is reabsorbed back in proportion to its lumen concentration is inevitable.

It may then be supposed that the subject drinks water so that his urine rate reaches 800 ml. per hour. The clearance will remain unchanged, so that the amount of urea reabsorbed is the same as before, but at the same time the lumen concentration has fallen to upwards of one fourth its previous value, from which we may conclude in turn that the back absorption of urea is independent of its lumen concentration. This contradicts our previous conclusion.

Put in another way, it may be said that from the present clearance-reabsorption views, the excretion of urea or urea clearance should rapidly and asymptotically approach that of inulin beyond a urine rate for the human subject of about 120 ml. per hour. Of this it may be said with certainty there is no sign; since even if recent work[4] has shown a rise in the urea clearance with increasing rate, it goes parallel to the inulin clearance, which has been regarded as a standard for measuring the glomerular filtrate.

E. J. CONWAY.

University College,
Dublin. Jan. 25.

[1] Addis and Drury, *J. Biol. Chem.*, **55**, 105 (1923).
[2] Van Slyke and Peters, "Quant. Clin. Chemistry" (London).
[3] Shannon, *Amer. J. Physiol.*, **112**, 405 (1935).
[4] Shannon and Smith, *J. Clin. Invest.*, **14**, 393 (1935); Shannon, *Amer. J. Physiol.*, **117**, 206 (1936).

Decomposition of Organic Peroxides

IN order to study the influence of peroxides on the oxidation of hydrocarbons and to discover the part they play in the phenomenon of ignition, the mode of their decomposition and oxidation is being further investigated. It has been found by Neumann[1] that diethylperoxide decomposes with luminescence above pressure limits (p_0) which are connected with temperature according to the relation $\log p = A + B/T$. We find that A and B depend on the dimensions of the vessel in which the decomposition occurs. Up to the neighbourhood of the sharp pressure limits the peroxide decomposes unimolecularly with an activation energy 34 kgm. cal. The influence of foreign gases (such as helium) on the pressure limits appears to be small, and similar to the behaviour of such gases on the decomposition of azomethane[2].

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Feb. 23.

[1] *C.R.*, 205, 278 (1937).
[2] Allen and Rice, *J. Amer. Chem. Soc.*, 57, 310 (1935).

Meteoric Ionization in the *E* Region of the Ionosphere

IN a letter which recently appeared in these columns[1], T. L. Eckersley described the discovery of great numbers of short-lived ionic clouds in the upper atmosphere. He suggests that the responsible agents might be small meteors or high-speed particles of cosmic origin. His data support the assumption of a meteoric origin so strikingly as to warrant special emphasis.

These clouds appear in the *E* region of the ionosphere in which meteors are known to spend most of their energy and from which most of the meteoric reflections of radio waves have been obtained. They are apparently short-lived isolated clouds in which momentarily the ionization reaches a value much higher than the average. This is precisely the sort of thing to be expected from the passage of a small meteor. Since a very bright one (−1 mag.) left sufficient ionization to reflect 180 metre waves for 7 minutes after its passage[2], the short period (of the order of a second) during which reflections are received from these clouds is consistent with their magnitudes. For since there are many more of these clouds than there are meteors as seen by a single observer, the meteors producing them must be fainter than the sixth magnitude on the average.

On the basis of telescopic observations, it has been estimated[3] that 10^9 meteors (of eighth magnitude or brighter) enter the earth's atmosphere every twenty-four hours. One should thus expect about 180 such meteors in an area 500 km. in diameter in 40 seconds. Eckersley found for these conditions about 30 ionic clouds or 1/6 as many as the estimated number of meteors. The agreement is as good as could be expected considering the nature of the phenomenon.

Even ultra-short waves which are not ordinarily reflected by the ionosphere might be expected to suffer reflection by ionic clouds of meteoric origin. L. F. Jones[4] has reported observations on such waves which might have this same primary cause. Regarding television signals, which are not ordinarily received with usable field strength at the long distance over which he was working (284 miles), he states: "Sometimes the signal would burst through sharply for a short period . . . ," and again, "the signal . . . reaches momentarily an occasional maximum of great intensity".

Ionic clouds of meteoric origin must be discrete regions in which the ionization is very dense. The rate of recombination would therefore be high and the life of the clouds would be short. This reasoning is consistent with the observed short duration of reflections and again points to the meteoric origin of Eckersley's clouds.

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Jan. 11.

[1] NATURE, 140, 846 (Nov. 13, 1937).
[2] Skellett, *Proc. I.R.E.*, 23, 132 (Feb. 1935).
[3] Watson, F., Harvard Tercentenary Papers, No. 32.
[4] Jones, L. F., *Proc. I.R.E.*, 21, 349 (March 1933).

Disintegration Processes by Cosmic Rays in Plates impregnated with Samarium

Blau and Wambacher[1] have recently described experiments in which it appears that a novel type of disintegration may be provoked by cosmic radiation. 'Stars' of tracks due to heavy particles were found in plates which had been exposed for some months at a high altitude. For two years we have been conducting experiments of the same type. We find stars of a similar kind, but there are important differences between our results and those of the Vienna workers, which are indicated below.

The experiments were commenced with the view of discovering whether the cosmic radiation has any influence on the radioactivity of samarium. Ilford *R* plates were used, and samarium was incorporated into the emulsion by soaking part of the area of each plate in a solution of samarium sulphate. After exposure and development the boundary of the impregnated area is visible on the plate. After preparing a number of plates in this way they were sealed in a small box, along with untreated plates for subsequent comparison. One such box of plates was kept for five months, May–September, at Gulmarg in Kashmir (latitude 34° N.). A similar box of plates was kept for an equal period in Bombay, being placed in a refrigerator to avoid the deleterious effects of the high temperature. After allowing for the thickness of the packing and the roof of the building, it may be assumed that the Kashmir plates were at an equivalent height of 8,000 ft. above sea-level. The Bombay plates were practically at sea-level.

In the first set of experiments carried out in 1936, some stars of tracks were found. The plates, however, were unfortunately rather poor, and we were not able wholly to exclude the possibility of some radioactive contamination. The experiments were therefore repeated in 1937, taking every possible precaution. This time good plates were obtained, which have yielded the following results.

(1) Both in the Bombay and Kashmir plates, we find practically no tracks in the untreated plates, nor in the blank areas of the treated plates. The only tracks found are those due to the natural radioactive content of the glass, such as were described in an earlier paper[2]. This result contrasts with that

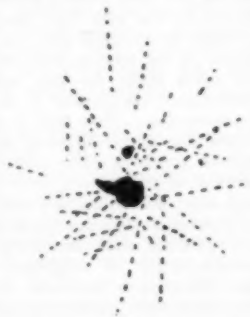
of Blau and Wambacher, who find stars in untreated plates. The difference may possibly be traced to the different sensitivity of the plates employed.

(2) In the treated areas of both Bombay and Kashmir plates, numerous tracks are found which are due to the short-range α-particles which are emitted by samarium. The number of such tracks gives a convenient indication of the quantity of samarium incorporated into the emulsion. The tracks of longer range, previously ascribed to protons[3,4], are also observed, with much the same relative frequency as in previous experiments.

(3) Numerous stars are found in the treated areas of the Kashmir plates. These stars comprise from two to six tracks. (It may be noted that contamination by radiothorium would only give stars of five tracks[5].) The ranges and directions appear to be distributed at random, and the maximum ranges do not exceed 5 cm. of air.

(4) The treated areas of the Bombay plates are apparently almost free of stars. Further search has still to be made, but in the considerable area already examined only one star has been found. In any event their relative frequency, as compared with the stars in the Kashmir plates, must be well below 1 : 100.

(5) We observe, in the treated areas of the Kashmir plates, but not in the Bombay plates, a phenomenon of an apparently different kind which we call a 'cluster'. This is best indicated by the accompanying sketch. Numerous tracks, up to about 40 in number, emerge from a limited area, but not from a point. Twelve such clusters have been observed. It has been pointed out previously[3] that *R* plates occasionally show a single very large grain of silver bromide, which appears on the developed plate as a black area having a diameter of perhaps 10 μ. We find that such a large grain is situated in the central region of seven out of the twelve clusters. As the large grains are relatively rare, it is clear that this cannot be fortuitous, and we must therefore conclude that the clusters, or some of them, are associated with the presence of silver or bromine.



(6) Both in the stars and in the clusters the individual tracks appear to be due to protons, judging by the density of grains along the track, but we cannot be certain of this conclusion.

It is perhaps premature to offer any interpretation of these results, of which we hope to publish a fuller account elsewhere. Further experiments are in progress.

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Wilson College,
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Jan. 29.

[1] Blau and Wambacher, NATURE, **140**, 585 (Oct. 2, 1937).
[2] Taylor, *Proc. Roy. Soc.*, A, **150**, 382 (1935).
[3] Taylor, NATURE, **136**, 719 (1935).
[4] Taylor and Dabholkar, *Proc. Phys. Soc.*, **48**, 285 (1936).
[5] Taylor and Dabholkar, *Proc. Ind. Acad. Sci.*, **3**, 265 (1936).

Factors influencing Stability of Superlattices

IN metallic solid solutions atoms of the different elements are usually distributed at random throughout the lattice. In certain cases, however, an ordered distribution, or superlattice occurs. The transformation from order to disorder has received considerable attention because the simplicity of the process renders it susceptible to theoretical interpretation. The entropy change is practically equal to the entropy of mixing, which can be calculated from first principles. The ordered state, which has the lower entropy, will be stable only when its internal energy is lower than that of the disordered configuration.

Two factors influencing the energy of ordering have been recognized, namely, forces between neighbouring atoms and lattice strains due to differing atomic sizes. It has not been emphasized, however, that both factors operate simultaneously. In the ordered state, atoms tend to be surrounded by foreign atoms. Hence attraction between unlike atoms stabilizes the superlattice. Hume-Rothery and Powell[1] point out the second factor that lattice strains due to differing atomic sizes will be less in the superlattice. The energy of ordering is thus due partly to interactions between neighbouring atoms and partly to geometrical strain. The latter factor is predominant in chemically similar atoms.

It occurred to us that these factors could be separated in studying the effect of silver on the gold-copper superlattice. When some of the gold atoms are replaced by silver atoms, which are practically the same size, the geometrical factor remains constant. Any change must be due to difference in attraction between neighbours.

The fifty atomic per cent gold-copper superlattice is most suitable for study since a change of symmetry, easily detectable by X-rays, occurs when the lattice becomes ordered. In the disordered state each gold atom has on the average six copper and six gold neighbours, while in the ordered state there are eight copper and four gold neighbours. The non-geometrical part of the energy of transformation is due to the breaking up of gold-gold and copper-copper pairs to form gold-copper pairs.

$$\text{Au : Au} + \text{Cu : Cu} = 2\ \text{Au : Cu}$$

Silver atoms substituted for gold should go into the gold superlattice positions, and part of the above process now consists in the breaking of silver-gold pairs to form silver-copper pairs.

$$\text{Ag : Au} + \text{Cu : Cu} = \text{Ag : Cu} + \text{Au : Cu}$$

Deviation from Vegard's law of additivity of atomic radii has been proposed as a measure of forces between atoms in alloys[2]. Strong attraction should result in pulling atoms closer together, resulting in a negative deviation from Vegard's law, while positive deviation indicates a weak attraction. In the absence of direct measurements of heats of reaction, this is our best criterion.

Accepting deviation from Vegard's law as a measure of forces between atoms, the results of the above experiment may be predicted with confidence. Silver-gold has a negative deviation, indicating strong attraction, the copper-gold deviation is positive indicating weaker attraction, while the silver-copper attraction is weakest of all. Hence it is more difficult to break the strong silver-gold pairs to form the weak silver-copper pairs in the ordering process represented by the second equation above than to carry out the corresponding process in the first equation. Silver

should thus decrease the stability of the superlattice, lowering the transformation temperature.

Our experiments give the predicted results. As silver is substituted for gold, the transformation temperature gradually decreases. For example, in an alloy of 46 atomic per cent gold, 4 silver, and 50 copper the transformation occurs near 360° C., while in the 50 gold-50 copper alloy the transformation temperature is considerably higher, best reports[3] placing it near 425° C.

Since the energy of ordering can be approximately calculated from the transformation temperature and the entropy change, this furnishes a semi-quantitative comparison of the energies of interaction between the pairs concerned.

We are also determining accurately atomic volume and axial ratios at different annealing temperatures. We confirm the existence of the orthorhombic phase reported by Johansson and Linde[4] and find that it persists after long periods of annealing at temperatures lower than they report. We hope to publish the complete results elsewhere after our work is concluded.

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[1] Hume-Rothery, W., and Powell, H. M., *Z. Krist.*, **91**, 23 (1935).
[2] Jette, E. R., *Trans. A.I.M.E.*, **111**, 75 (1934).
[3] Hansen, M., "Aufbau der Zweistofflegierungen" (Julius Springer, Berlin, 1936).
[4] Johansson, C. H., and Linde, J. O., *Ann. Phys.*, **25**, 1 (1936).

Some Observations on the Rotating Pendulum

WHEN a simple harmonic pendulum is viewed binocularly with a neutral-tint filter in front of one eye, the pendulum, instead of swinging to and fro in a plane, appears to swing in an ellipse, first advancing towards and then receding from the observer[1]. The simplified but not quite true explanation of the illusion is that the 'latent period' of vision in the unobscured eye is shorter than that in the other eye, the brighter retinal image being followed by the shorter latent period. If with a pendulum swinging from right to left, both eyes fixate the true position in space of the pendulum, then the right eye will project the pendulum along a line to the right of the line of fixation whilst the left eye if obscured will project it along a line still more to the right of its line of fixation. The lines of projection will intersect at a point on the observer's side of the pendulum and this is the position in space which the pendulum will appear to occupy. Similarly it can be shown that the pendulum will appear to recede from the observer when passing from left to right and that its point will trace out an ellipse. Using a movable pointer beneath the pendulum, an observer can measure the apparent forward displacements with filters of varying densities in front of one eye and it is possible to calculate the difference in time (sec.) between the latent periods of the two eyes (ΔLP) for any given ratio between the retinal illuminations of the two eyes (I_u/I_o). I find that the relation is $0{\cdot}02 \log_{10} I_u/I_o = \Delta LP + c$, where c is a small constant depending on the difference between the latent periods of the unobscured eyes. The relation holds accurately for any one illumination of the pendulum, but with any given filter ΔLP becomes smaller if the illumination is considerably increased.

With the filter in front of the right eye the pendulum will seem to swing anti-clockwise, and provided the eyes are treated alike in other ways, we are probably justified in saying that because the right retinal image is less bright, the latent period is longer. It might be thought that a source of light shining into the right eye would lower the apparent brightness of the pendulum by simultaneous contrast. This in its turn might lengthen the latent period and the apparent motion of the pendulum would be anti-clockwise. This, however, is not so, and with an illumination of 15 ft.c. on the pendulum, a small electric torch shining into the right eye from a distance will produce a considerable clockwise rotation. Contrary to expectation, the extraneous source of light shining into the right eye has decreased and not increased its latent period. This result is probably due to nervous interaction between various parts of the retina since the illusion decreases progressively when the angle between the pendulum and the light source is increased, finally disappearing at about 30°. In addition, the illusion is not obtained when the image of the light source falls on the blindspot.

The illusion also appears when one eye looks through a sheet of glass in which is reflected the light from the open sky, and it does not matter whether the reflection of the sky covers the pendulum completely or merely covers the field of vision to one side of it. The latent period always appears to be shorter in the eye with the additional illumination. It might be thought that these experiments could be explained by saying that scattered light within the eye adds itself to the retinal brightness of the pendulum's image and so shortens the latent period of perception. That this is not the true view can be shown by the following experiment. When the electric torch is held close to one eye for a few seconds, that eye still has the shorter latent period even after the torch is removed. To the dazzled eye the pendulum appears much darker than to the normal eye, showing that the latent period can be varied independently of brightness and that there is no rigid connexion between them. The dazzled eye has apparently gained in quickness of perception but has lost in other ways. Frank Allen[2], working on the critical frequency of flicker, argued that because the fusion frequency of a test patch was higher when other parts of the retina were illuminated, that, therefore, the apparent brightness was higher. A given visual brightness is not followed by an unvariable latent period, and it is doubtful whether Allen was justified in assuming that, because the fusion frequency was raised, the apparent brightness was also higher.

It is rather surprising that the pendulum appears to swing almost straight after one eye has been dark adapted for five minutes or so, and we must conclude that the retinal interaction is largely confined to the mechanism of photopic vision.

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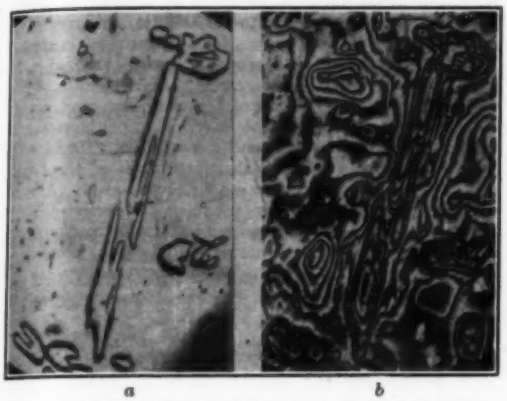
[2] Allen, F., *J. Opt. Soc. Amer.*, **13**, 383 (1926).

Metallography: a New Technique

THE interference fringe technique for examining the topography of metal surfaces (previously used to study superficial irregularities in the coating of tin-plate[1]) has now been improved and its applications extended. The technique consists in observing or photographing the interference fringes that form between a partly silvered optical flat and the metal surface under examination. A detailed 'contour map' of the surface is thus obtained, the vertical spacing of the contours being one half the wave-length of the monochromatic (sodium) light used.



a *b*

ETCHED BABBITT METAL. (*a*) VERTICAL ILLUMINATION; (*b*) INTERFERENCE FRINGES ON THE SAME FIELD. (× 100).

A simple application of the technique is illustrated in the accompanying figure. The surface is that of a tin-base, tin-copper-antimony alloy (babbitt metal) which has been metallurgically polished and very lightly etched with 0·5 per cent nitric acid in ethyl alcohol. (*a*) is a photomicrograph taken with ordinary vertical illumination; (*b*) shows the fringe formation on the same field. It is apparent that the acicular structure of the copper-tin compound is at a level different from that of the ground-mass. The direction and extent of this difference can be easily determined.

In general, this technique can be applied to the study of any action which may give rise to characteristic differences of level in a surface. Irregularities caused by polishing a surface the constituent phases of which are not of equal hardness, or caused by differential attack of etching reagents due either to distinct phases or to varying crystal orientations of the same phase or to boundary effects, are all susceptible to study by the technique, and we hope to report more fully on some of these aspects in due course. The study of electro-deposited surfaces is also in hand.

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[1] Hoare, W. E., and Chalmers, Bruce, *J. Iron and Steel Inst.*, **132**, 135 (1935).

The Kurumi (Japan) Meteorite

MR. YASUAKE IBA, a well-known Japanese amateur astronomer, wrote to the Harvard Observatory on October 7, 1934, that he had examined a meteoritic stone which fell near Kobe, Japan, on May 27, 1930. No reference to this fall appeared in two recent bibliographies of meteorites[1]; and for the completeness of the records it appears advisable to make known the information supplied by Mr. Iba.

At about noon on May 27, 1930, in Kurumi, a village near the town of Miki, north-west of Kobe, Mr. Jitsuzo Kuriyama and his wife were about to take tiffin when a rumbling sound attracted their attention. Suddenly something fell on the roof of their house. They rushed outside and saw steam rising from a near-by ditch and from it they dug out the main portion of the meteorite, 38 gm., 4 cm. × 3 cm. On the ground under their roof was found a fragment of 8 gm., 2 cm. × 1 cm., which was too hot to handle immediately. "The roaring sound in the sky which lasted for some time was so striking that the mechanics, busily engaged in the making of farm implements amidst a boisterous clamour of running motors, had to stop swinging their hammers to listen to it. . . . For the sound and the mass of the meteorite the damage was very slight, only one tile having been cracked."

The photograph (as reproduced herewith) and description sent by Mr. Iba show the stone to be a chondrite of "light sky-blue tint with yellowish granular particles (small patches) intermixed". (Only the two fragments were recovered, although others surely fell.) The name adopted in Japan for this fall is Kurumi Inseki (Kurumi meteorite), and Kurumi

is apparently the name which should be generally adopted. The depository of the meteorite was not communicated, but can probably be given by Mr. Iba, whose address is Ohte, Kobe, Japan.

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[1] Heide, F., *Forts. Mineralogie*, **27**, 225 (1937). Nininger, A. D., *Popular Astronomy*, **45**, 451 (1937).

The Australian Aborigines

MAY I refer briefly to the important article on the Australian aborigines published in NATURE of December 18, 1937.

When Europeans took charge of the continent in 1788, there were, it is estimated, about 300,000 aborigines who had adapted themselves to the hard conditions of the Australian bush and had developed totemism and elaborate tribal customs. There are now none in Tasmania, about fifty in Victoria and a few in New South Wales. But in tropical Australia there are about 60,000, many of whom are afflicted with diseases, introduced by various races, and there are about 22,000 half-castes, European, Chinese, Japanese, etc., who are rapidly increasing.

The opinion of anthropologists seems to be that the pure aborigines will not survive unless they are placed on areas into which non-aborigines may not enter except on duty and where they may continue to live as they have always done. It is sometimes said by way of criticism that they have never cultivated an Australian plant or domesticated an Australian animal. This is, I believe, correct; but, in fairness, people must be reminded that the European has never succeeded himself in doing either of these things. Indeed, Governor Philip with his first party in Sydney in 1788 would in all probability have died of starvation where the aborigines thrived unless he had shipping resources at his disposal. Even then, he was hard put to it to save the settlement.

But biological historians remind me that the domesticated animals and cultivated plants, even in Europe, are prehistoric in origin though they have been developed out of recognition by skilled breeding.

The Australian aborigine missed the opportunity, if it ever existed, of domestication and cultivation. As it is, the life of a European lost in the bush is usually very short. The feeling in Australia with regard to the preservation of the aborigine is growing steadily but the task is not easy. Medical care there must be, and I am personally of opinion that it will succeed only when either the aborigines or the half-castes are trained in medicine to some extent. Many of them can be useful on pastoral properties. The half-castes are often capable, and will, and must, be absorbed into the general population. It is in this direction that the missions can render great service and I believe in at least one instance are taking useful action.

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Points from Foregoing Letters

DIALYSED extract of yeast, to which yeast adenylic acid is added, phosphorylates only glycogen and not glucose, according to H. Lehmann. As in the case of muscle extracts, this reaction, in which hexosemonophosphate is formed from glycogen and inorganic phosphate, reaches an equilibrium. The breakdown of glycogen to hexosemonophosphate is inhibited by glucose, a fact which may have a bearing on the regulation of carbohydrate metabolism in the living organism.

The magnesium content of hedgehog serum increases from an average of 3·20 mgm. per cent in the autumn, before the onset of hibernation, to an average of 5·43 mgm. per cent in January, during hibernation. This increase in the concentration of magnesium ions, unaccompanied by a corresponding increase in the concentration of calcium ions, produces, according to Dr. P. Suomalainen, an anæsthetic effect.

Prof. E. J. Conway states that the view that there is a constant rate of filtration of urine at the glomerulus and that variations in the urine volume excreted are almost entirely due to different volumes of water reabsorbed in the passage through the tubules, leads to a contradiction: on the one hand, the average 'clearance value' after administration of urea (so as to increase its concentration in the blood) remains the same, which shows that urea is reabsorbed in proportion to its 'lumen' concentration. On the other hand, increased rate of flow of urine through drinking more water also leaves the 'clearance value' unchanged, which indicates that the amount of urea reabsorbed is the same as before, hence unaffected by its lumen concentration.

Prof. A. M. Skellett points out that the number of meteors of the 8th magnitude or brighter, estimated on the basis of telescopic observations, entering the earth's atmosphere could account for the 'ionic clouds' detected in the *E* region of the upper atmosphere from their effect upon radio waves. The ionic clouds produced by meteors would have high ionic density and short duration.

The presence of 'stars' and 'clusters' of tracks, apparently due to protons, upon photographic plates impregnated with samarium and exposed to the action of cosmic rays at a high altitude in Kashmir (equivalent height 8,000 ft. above sea-level) is described by Prof. H. J. Taylor, D. Fraser and V. D. Dabholkar. The clusters appear to be associated with the presence of silver and bromine. Control plates at Bombay did not show the phenomenon to any appreciable extent.

R. Hultgren and L. Tarnopol find that substitution of silver for gold in gold-copper alloys decreases the temperature of transformation from the 'ordered' state—in which a gold atom is surrounded by eight copper and four gold atoms—to the 'disordered' state—in which each gold atom has on the average six gold and six copper neighbours. The experiments were carried out to determine the 'energy of ordering' due to interactions between neighbouring atoms, as distinct from that due to geometrical strain and the results, the authors state, agree with the predictions.

Dr. R. J. Lythgoe, using Pulfrich's rotating pendulum, calculates the increase in 'latent period' of vision produced by a given decrease in retinal illumination. Contrary to expectation, 'glaring' sources of light decrease the latent period both at the time and afterwards. The phenomenon is probably due to nervous interaction in the retina.

Describing a new metallographical technique, B. Chalmers and W. E. Hoare show that microscopic differences of level in a metal surface can be accurately measured by examining the interference fringes formed between the surface and a partly silvered optical flat.

Research Items

Effect of Physical Culture upon Women

THE results of an experiment conducted at the University of Minnesota on the effects of physical education for women have recently been issued ("Measurement of Outcomes of Physical Education for College Women". By Elizabeth Graybeal. University of Minnesota Press). Freshly entering women students were divided into two groups, one of which participated in a course of physical education, while the other control group did not. It was found that during a one-year period of experimentation, the experimental group made significantly—that is, statistically—greater gains than the control in attitudes towards health and physical education activities, in knowledge of health and physical education, and in general motor ability. In contrast to this result, the Health Organisation of the League of Nations (*Bull.* of the Health Organisation, **6**, No. 4, p. 551) considers that women less than twenty-one years of age are not fitted for strenuous athletic effort, that the female organism fails to respond to intensive training, and that the majority of light athletics should be banned for women, flat racing being limited to 60–80 metres. Long runs, fencing, boxing and wrestling are considered unsuitable for women.

Mental Hygiene of Intellectual Work

DR. C. S. MYERS points out that, owing to the wide range of individual differences, it is impossible to lay down definite laws of mental health with regard to intellectual work ("The Mental Hygiene of Intellectual Work", *Occupational Psychology*, **12**, No. 1). Some intellectual workers have done excellent work under the influence of drugs, whereas others have found them detrimental. Some work best when living a strictly ordered life, others when extremely irregular. Some work best at night, and some in the daytime. In learning and thinking, the emotional and conative factors are of fundamental importance: irritation, worry, anxiety, obsessional tendencies, and the consequences of other maladjustments and conflicts are obviously detrimental. Therefore normal affective conditions and unobstructed volition must be our ideal; thus it is not enough to 'train the intellect', since the whole personality in harmony with its social setting must be developed. Nor can we rule out the importance of interest and native talents. No intellectual work can be successfully performed without intellectual discipline, which, however, must not be understood as synonymous with mere routine. Interesting exercises could be planned and practised in order to improve intellectual work, with the result that disturbing impulses will be better controlled, thereby facilitating concentration and voluntary effort. Again, intellectual work has to be performed by means of the body and in a particular environment. There is a real need, therefore, for adequate food, exercise and sleep, as well as for the necessary material environmental conditions, such as lighting, heating, ventilation, and so forth.

Periodical Fluctuations in Game

PERIODICAL fluctuations in the number of individuals of various species is now well known and has been attributed to various causes. Mr. J. Baashuus-Jessen discusses this in regard to the smaller mammals of Norway in recent years in *Norges Svalbard-og Ishavs-undersökelser* No. 36 (Reprinted from *Norges Jeger-og Fiskerforbunds Tidsskrift*, Hefte 2 and 3, 1937). In 1934 there was a superabundance of small rodents, especially voles. This led to an increase in the number of foxes, stoats, buzzards, eagles and hawks and even of wolves. By 1935, the abundance of small rodents had stopped and there was a reduction in the number of hares and game birds which the beasts of prey had devoured, and these beasts in turn had become numerous. The year 1936 was marked by a great scarcity of game, but now it is expected that this will cause a reduction in numbers of foxes, eagles, hawks, etc. Mr. Jessen, while admitting the possibility of epidemics in reducing numbers of rodents, or their absence in allowing increase, thinks that climatic causes are more potent. A sudden thaw causes the drowning of lemmings. Drought or sudden frost may diminish nutriment and cause the prevalence of deficiency diseases. Migration, reduced fertility and diminished power of resistance to virus diseases may also result.

Snakes of Yucatan

THE peninsula of Yucatan juts into the Caribbean Sea from the mainland of Central America, and at its opposite ends exhibits extremes of meteorological, faunal and floral conditions. The composition of its fauna is therefore a matter of unusual interest. A collection of snakes, made by E. Wyllys Andrews in the States of Yucatan and Quintana Roo in 1937, was found by him to include forty-two species. Of these, the majority (24) belong to widespread species, six to sub-species which are off-shoots of forms found in the regions bordering the peninsula, and twelve are distinctive forms not connected by intergradation with the inhabitants of neighbouring areas (*Zoo. Ser. Field Mus. Nat. Hist.*, **20**, No. 25, 355). The last of these groups seems to represent the relic of an earlier fauna which has now in part disappeared in the territory adjacent to Yucatan; while the second may represent adaptations of a later fauna to the peculiar ecological conditions of the northern part of the Peninsula. Some of the characteristic Yucatan species have been found to extend southward in the peninsula beyond the limits of the scrub forest.

Breeding Peculiarities of Hornbills

R. E. MOREAU directs attention to the curious breeding habits of African hornbills (Bucerotidæ), the females of which are enclosed in the nesting hole for periods which range from about six to ten weeks (*Proc. Zoo. Soc. London*, Ser. A, 33; 1937). This lengthy imprisonment includes a long period of brooding inactivity, the incubation of the eggs, and the partial development of the young to within three or four weeks of fledging. It covers also the moulting

period of the female when she undergoes so wholesale a change that not only is the power of flight lost, but her body becomes almost naked. It is unlikely that non-breeding females should be subject to a process so drastic and dangerous, but evidence in their case is lacking. Problems of sanitation, intensified by the crowding of nestlings and parent in a restricted space, are overcome by forcible defecation at the entrance of the nest, by the ejection of other rubbish, such as egg shells and feathers, and by the 'casting' of indigestible remains. During the period of incarceration of the whole family, the male is solely responsible for food-getting, but in *Lophoceros* the female helps to feed the young after her emergence. In this genus the young, whenever the female leaves them, at once elaborate plaster, re-seal the entrance to the nest, and undertake the scavenging work formerly carried out by the mother bird.

Shells of Mauritius

THE Revised Catalogue of the Testaceous Mollusca of Mauritius and its Dependencies by R. Viader (Mauritius Institute Bulletin, 1, Part 2, January 1937. Published by the Board of Directors of the Mauritius Institute and Public Museum) is an important and valuable addition to conchological literature. So much more is known of the Mollusca of Mauritius since the publication of von Marten's catalogue that the present up-to-date work was greatly needed, compiled as it is in accordance with modern classification. It is hoped that it will pave the way for the proposed thorough revision of the local fauna with bibliographical references, critical observations and ecological and other notes. The marine species and varieties listed in this catalogue number 2096 univalves and chitons and 279 bivalves, making a total of 2375, which exceeds by more than 1000 the number of shells reported by von Marten from the Mascarenes, the Seychelles and Madagascar. A number of species from recent gatherings are still awaiting description, and these will considerably enlarge the list.

Woodlice of Iceland

ONLY five species of woodlice have been recorded from Iceland; of these one—*Oniscus asellus*—is included, on very slender grounds, and two others, species of *Porcellio*, have been found only once. The distribution of the remaining species, *Trichoniscus pusillus* and *Porcellio scaber*, is confined to the south of the island, with the exception of three northern records ("Zoology of Iceland", 3, Pt. 28; 1938). Thydsen Meinertz suggests that the explanation of this localized distribution may be that Iceland is on the northern limit of the range of these woodlice, and that the milder insular climate of the southern part may afford suitable conditions while the continental climate of the northern area is too severe to permit of colonization. The suggestion is supported by the absence of woodlice in Greenland and by the solitary record from Norway north of Lofoten.

Monocotylous Seedlings of Some Dicotyledons

MOST dicotyledons, as their name implies, possess two cotyledons, whereas monocotyledons have one; but certain dicotyledons show only one cotyledon (at any rate, at later stages in germination). Sir Arthur Hill has made some interesting observations on some of these monocotylous dicotyledons, especially on certain genera of Gesneriaceæ, and has recently published his findings, considered with observations on other species of plants (*Ann. Bot.*, New Series, 2, January 1938). Miss E. Sargant's theory (*Ann. Bot.*, 12; 1903), based on observations on the cyclamen, lesser celandine, etc., that the single cotyledon of monocotylous dicotyledons represents two fused cotyledons is shown to be untenable. Evidence is brought forward that the second cotyledon is either rudimentary and capable of development as in cyclamen, or wholly suppressed as in certain other genera. In certain species of *Peperomia*, the second cotyledon is an absorbent organ and never leaves the testa. In all genera of Gesneriaceæ studied, one of the two cotyledons was shown to cease growth at an early stage, and abort. The comparative morphology of the later stages in development of these genera of Gesneriaceæ is also discussed. The paper is illustrated by three plates of photographs and 23 text-figures.

Factors affecting Protein Content of Leaves

IN the first of a series of investigations on nitrogen metabolism in plants, A. H. K. Petrie and J. G. Wood have studied the relation between the content of proteins, amino-acids and water in leaves (*Ann. Bot.*, New Series, 2, No. 5, January 1938). Experiments were performed on pure-line grasses, *Phaloris tuberosa* and *Lolium multiflorum*. The results obtained suggest that, in certain respects, the protein content of leaves varies directly with amino-acid and water content, and evidence was also obtained that the protein content increases with the *p*H of the expressed sap. It is suggested that the rate of formation of protein from amino-acids decreases with a reduction in water content, though it has not yet been established whether this decrease is due to decrease in protein synthesis or increase in protein hydrolysis, or both.

Ice in Finnish Waters

THE distribution of sea-ice on the Baltic coasts of Finland is the subject of an exhaustive memoir by Dr. R. Jurva entitled "Über die Eisverhältnisse des Baltischen Meeres an den Küsben Finlands" (No. 114 Merentutkinuslartoksen Julkaisu Havsforsknings Institutets, Helsinki, 1937). A feature of the study is the discussion of the ice distribution in various years so far as past records are available. Since all the Baltic coasts of Finland are to a greater or less extent fringed with ice in winter and so largely inaccessible to commerce, the records of the past are fairly numerous. The memoir is accompanied by an atlas of some fifty pages of maps and graphs of the ice distribution at all times of the winter. The maps give a clear view of the duration of frozen waters along the coasts.

Isocholesterol and Isomeric Ethers of Cholesterol

IN 1937, E. S. Wallis, E. Fernholz and F. T. Gephardt (*J. Amer. Chem. Soc.*, 59, 137; 1937) by the action of anhydrous potassium acetate on cholesteryl *p*-toluene sulphonate in acetic anhydride obtained a new isomer of cholesterol which they called isocholesterol, and suggested that the reaction is accompanied by molecular rearrangement. A close relationship was suggested between this new alcohol and the isomeric ethers of cholesterol obtained by Stoll in 1932. It was further shown by E. G. Ford and E. S. Wallis (*ibid.*, 59, 1415; 1937) that

the abnormal ethers of cholesterol recently referred to in the literature as "*cis*-cholesteryl ethers" are really ethers of isocholesterol. E. G. Ford, P. Chakravorty and E. S. Wallis (*ibid.*, **60**, 413; 1938) have now substantiated the formula suggested for isocholesterol by a series of reactions involving oxidation and reduction. It appears that the hydroxyl group in this compound is in the six position of the sterol molecule and hence during its formation from cholesteryl *p*-toluenesulphonate a molecular rearrangement occurs.

Tetrahedral Angles in Butane Derivatives

THE tetrahedral form for the gas molecules of the tetrafluoride, tetrachloride and tetrabromide of carbon has been proved by the method of electron diffraction. Many other molecules, such as methylene chloride and chloroform, have been shown to be only slightly distorted from tetrahedral symmetry. Because of the electrostatic and steric repulsions of the methyl groups it is to be expected that the C-C-C angle in isobutane will be slightly greater than the tetrahedral angle 109° 28′. In the case of tertiary butyl chloride and bromide the increased steric repulsion between halogen and hydrogen atoms will be expected to decrease the C-C-C angle below that in isobutane and possibly below the tetrahedral angle. The electrostatic attraction of the negative halogen atom for the positive hydrogen atoms, on the other hand, would tend to spread the C-C-C angle. J. Y. Beach and D. P. Stevenson (*J. Amer. Chem. Soc.*, **60**, 475; 1938) have measured these angles by the electron diffraction method. They find that the C-C-C angle is never distorted more than 4°, the values being 113° 30′ ± 2° for isobutane, 111° 30′ ± 2° for *t*-butyl chloride and 111° 30′ ± 2° for *t*-butyl bromide. These results are in agreement with calculations. The interatomic distances are calculated as C-C 1·54 ± 0·02, C-Cl 1·78 ± 0·03 and C-Br 1·79 ± 0·03, A. units.

Allotropy of Mercuric Oxide

THE two forms of mercuric oxide, red and yellow, have been regarded both as allotropic forms and as the same form in varying states of division. A. B. Garrett and A. E. Hirschler (*J. Amer. Chem. Soc.*, **60**, 299; 1938) have determined the solubilities of the two forms in water, alkali and alkaline salt solutions. The solubility of the two forms can be represented by straight lines up to nearly 1 molal alkali and there is no perceptible decrease from the solubility in pure water. On the assumption that a hydroxide $Hg(OH)_2$ is formed, which is amphoteric, this result shows that the basic dissociation constant is very small, whereas the results for silver and copper oxides and cadmium hydroxide have shown substantially complete ionization. The value $K = [Hg^{\cdot\cdot}] \times [OH^{\cdot}]^2/[Hg(OH)_2]$ is calculated as $1{\cdot}8 \times 10^{-22}$. The solubility curves in pure alkali establish the amphoteric nature of mercuric oxide by the constancy of the equilibrium constant $K = [H^{\cdot}] \times [HHgO'_2]/[H_2HgO_2] = 1{\cdot}4 \times 10^{-15}$. The difference in free energy between the red and yellow forms is calculated as only 31 g.cal./mol, but this is not regarded as establishing the identity of the two forms. Microscopic examination showed that the particle size was 1–10 μ for the yellow and 10–30 μ for the red. A sample of red oxide finely ground had a solubility 5 per cent greater than that of the yellow oxide although its colour was redder than the latter.

Photochemistry of the Atmosphere

VARIOUS reasons may be given for supposing that the earth's atmosphere originally contained no free oxygen. Its formation may possibly be due to photochemical decomposition of water vapour and carbon dioxide, which were present in large quantities. W. Groth and H. Suess have investigated this assumption (*Naturwiss.*, **26**, 77; 1938). They point out that astrophysical observations indicate that solar radiation is very rich in exceedingly short wave-length ultra-violet. This does not reach the earth owing to absorption by oxygen and ozone, but the fact that lines due to excited nitrogen atoms occur in the spectrum of the night sky shows that radiation of wave-length about 600 A. must be present (Saha, *Proc. Roy. Soc.*, A, **160**, 155; 1937). When water vapour is irradiated with ultra-violet radiation of wave-length 1295–1470 A., obtained from a Harteck xenon lamp, it forms hydroxyl and hydrogen ($H_2O + h\nu = OH + H$). Similarly, carbon dioxide gives carbon monoxide and oxygen ($CO_2 + h\nu = CO + O$). If a mixture of carbon dioxide and water vapour is irradiated, the two reactions go on simultaneously and the products combine to form glyoxal or formaldehyde ($H + CO = HCO$; $2HCO = H_2CO + CO$, or HCO.HCO). Their presence was shown by Schryver's reaction. The process is clearly similar to that occurring in carbon assimilation by plants. Not only could this process explain the formation of free oxygen in the atmosphere, but also the production of organic compounds, from which organic life could develop. The fact that a process of this kind is still taking place in the atmosphere is shown by the work of Dhar and Ram (NATURE, **132**, 819; 1933), who detected as much as 1 mgm. per litre of formaldehyde in rain-water.

Degree of Accuracy in the Reduction of Occultations of Stars

MR. FRANK ROBBINS has recently dealt with the problem of the accuracy obtained in occultation reductions by three methods (*J. Brit. Astro. Assoc.*, **48**, 4, February 1938). These are, the method advocated by the late Dr. R. T. A. Innes, modified and adapted for logarithmic computation by the Computing Section of the British Astronomical Association; the new method described in "The Prediction and Reduction of Occultations", which is based on Dr. L. J. Comrie's paper in *A.J.*, **46**, 6, 1937; and a method described by Rev. Dr. M. Davidson in *J. Brit. Astro. Assoc.*, January 1938. Mr. Robbins points out that discrepancies amounting to 0″·3 or sometimes more occur in the results obtained by the first two methods. During the discussion at the February Meeting it was stated by Mr. D. H. Sadler, Superintendent of the Nautical Almanac Office, that each of these first two methods worked in units of 0″·1 in $\triangle\sigma$, and it was possible for the results to vary by one or two units, due to rounding off at different stages of the work. Dr. Davidson stated that he was not prepared to admit an error greater than 0″·04 by his method, and an error of 0″·1 would be utterly unjustifiable, especially if certain checks suggested by Mr. Robbins were utilized. In the February *Journal*, Dr. Davidson has a supplementary paper on the whole subject, in which he shows how considerably less work is entailed in the process of computation by his method, if functions of certain spherical co-ordinates are used instead of their direction cosines.

The Soviet Polar Enterprise

Some Preliminary Results

SOME preliminary results of the observations made on the drifting Soviet polar station are contained in articles supplied by the Soviet Union Year Book Press Service. Prof. V. Shuleikin, writing on currents and winds of the Arctic, says that the rate of drift of the ice is about three per cent of the velocity of the wind and that the drift deviated from the wind direction by so much as 45°. Further, he maintains that the pack-ice moves only by the action of the wind and that apart from the winds there were no surface currents observable in the Arctic Ocean. Thus there must obviously be a general prevalence of winds across the polar basin, for the observers are insistent that no sign of a circulatory movement of the floes within the basin was apparent. The East Greenland current is attributed to the persistence of north-west winds from the plateau of Greenland giving a southward movement, presumably in conjunction with the northward push of the ice due to the earth's rotation. It is said to be entirely a wind current.

Prof. N. Zubov points out that the conception of the Arctic as a region of continuous high pressure must be modified since cyclones penetrate to the region of the North Pole and bring relatively warm weather. If, however, the drift of the ice, which was principally to the south, is due solely to wind action it would appear that the wind must prevail from one direction and this may prove to be from the region of cold in north-eastern Siberia. There the radiation from a land surface results in lower winter temperatures than occur over the Arctic Ocean, where higher temperatures are maintained by the unfrozen water below the ice. The low pressure of the Greenland sea in conjunction with this high pressure over north-eastern Siberia would no doubt account for a pressure gradient leading to these transpolar winds. Previous observations on the winter drift of pack-ice north of Asia show some correlation with the air current from the Siberian high pressure area. In summer, northerly winds on the Asiatic coast, due to a change in pressure condition, fray out the edges of the pack towards the south. Comparable northerly winds seemed to have driven the Soviet floe southward on the other side of the Pole in summer.

Prof. L. Zenkevich, writing on the biological results, has little to say so far, except to record that fauna has been collected at depths of more than 1,000 metres. This is more than four hundred metres below the ridge between Greenland and Spitsbergen. Thus it would appear that the deep Arctic fauna is completely cut off from the faunas of the Atlantic and Pacific basins, and may well contain faunas of great interest. Lastly, Prof. O. Schmidt foresees further exploration of the inner Arctic basin by this novel form of transport on drifting ice, the only suitable means that has so far been adopted. The new magnetic observations will be a great help to future aviators, both in placing and removing such parties of floating observers. Aerial transport between Europe and the Far East will also be facilitat .

R. N. R. B.

Veterinary Science in India

IN his presidential address before the Section of Veterinary Research of the Indian Science Congress Association at its recent jubilee meeting in Calcutta, Sir Arthur Olver discussed "The Development of Veterinary Work in India". Sir Arthur gave a detailed history of the early pioneers of veterinary science in India and the great efforts they made to lay down the foundation upon which the present structure had been built. So long ago as 1788, Joseph Earl published in Calcutta an English translation of a Sanskrit work on the diseases of horses entitled "Saluter and Farrier", and in 1799 a number of qualified veterinary surgeons, graduates of the London Veterinary College, were drafted to India for the organization of cattle and camel breeding and the establishment of studs for the breeding of cavalry horses. The most prominent among these was William Moorcroft, who was appointed in 1808 by the East India Company as superintendent of their Bengal stud at Pusa, in North Bihai; and it is recorded that by improved management he reduced losses by 90 per cent, and amongst other things introduced the cultivation of oats into India. Unfortunately, whilst on an expedition to Central Asia on behalf of his scheme to improve the breed of remounts for India he was murdered, but his writings were of exceeding value, not only on veterinary subjects but also in connexion with agriculture; and he is credited with having placed the Kashmer shawl industry on a sound footing, and to have described a breed of mountain sheep with wonderful wool and to have given an account of a new species of the genus *Equus* which was neither horse, ass, nor mule, and which he thought might have been the 'Onagar' of Pliny.

In 1821, in consequence of the terrible losses from disease amongst the animals, the East India Company insisted upon veterinary surgeons forming part of the staff of the various depots, and arranged a system by which Indians could be trained as assistant apothecaries to the troops of the Bengal Army. In 1823 a scheme was promulgated for an organized veterinary service, but the Veterinary Department of India remained without an official head or a single administrative officer for forty years; spasmodic efforts to fight the many tropical diseases from which the animals suffered being undertaken only in districts where there happened to be stationed veterinary officers of the British and Indian cavalry regiments. It was one of these, Dr. Griffith Evans, of the Army Veterinary Department, who, in 1881,

for the first time, demonstrated a large flagellated organism, now known as *Trypanosoma evansi*—in the blood of horses and camels affected with surra, and this discovery was the pioneer work in the knowledge of protozoan diseases, and has since been of immense benefit to the human race as well as to livestock.

The years between 1860 and 1892 saw considerable advance in the organization of veterinary services in various provinces, and the formation not only of an army veterinary school but also several teaching schools and veterinary colleges. With these must ever be associated as pioneers the names of Hallen, Steel, Pease and Fred Smith; and in most provinces superior veterinary services were formed, officered by members of the Royal College of Veterinary Surgeons with subordinate services officered by graduates of the Indian Veterinary Colleges. The year 1891 marked one of the most important steps ever taken for the development of veterinary work in India, in the appointment of an Imperial bacteriologist; the sequel to which has been the establishment of the well-equipped and well-staffed Veterinary Research Laboratory at Muktesar. It was here that Dr. Lingard, who was the first Imperial bacteriologist, discovered the special affinity of arsenic for the parasite of surra; a discovery which has led to results of greatest importance to the human race. The more recent work of Dr. J. T. Edwards in the production of a goat virus of fixed and reduced virulence for the ox laid the foundation to what has proved a highly successful and economical method of controlling outbreaks of rinderpest amongst plains cattle, without the use of anti-rinderpest serum; the results being to confer a lasting immunity at a fractional cost of the serum methods which had been in vogue previously.

Sir Arthur Olver directed attention to the enormous field for scientific veterinary work which exists in India and deplores the paucity of trained scientific workers, and the heavy loss which could be avoided if more and more scientifically trained staff could be brought into action for combined veterinary and animal husbandry activities. He suggests that in addition to the five veterinary colleges which at present exist, at three of which the course is only three years, whilst at the other two the course is four, there should be added a Central India University Veterinary College. This would work in conjunction with the Veterinary Research Institutes of Izatnagar and Muktesar to train specially selected students who would be required to undergo a minimum of five and perhaps even six years of scientific veterinary research with special facilities for training in animal husbandry and a university matriculation to enable them to train up to modern standards and to carry out the higher diagnostic and research work which is so essentially necessary to control the epidemics of animals—especially in a tropical country like India, where the wealth and also the health of the people so largely depends on the health of its farm animals. As Sir Arthur said: "the field for such work is unlimited, and up to the present almost untouched."

The meeting of the Veterinary Section at the Indian Science Congress was well attended, and the papers on veterinary scientific subjects were of a very high order. One notable result ensued in that a proposal to add to future science congresses a Section of Comparative Medicine—in which medical men, veterinarians, physiologists, and those interested in animal husbandry could take equal part, was enthusiastically received and adopted.

The New Super-Novæ

A NUMBER of interesting notes on the discovery and the investigation of the two 'super-novæ', found within the course of a month, by F. Zwicky at the Mount Palomar Observatory, California, have been recently published in the *Astronomische Nachrichten*.

On an earlier occasion Zwicky (*Proc. Nat. Acad.*, 22, 459; 1936) had emphasized the great importance of extensive observation of these unique objects. Super-novæ radiate during several weeks as much energy as a whole galaxy of stars, and thus these data may furnish most valuable information on fundamental problems, such as the generation of energy in stars, the evolution of stars and stellar systems, the origin and the characteristics of cosmic rays travelling in space.

The latest discoveries, as well as earlier ones, for example, that in the nebula *NGC* 4157 in February 1937, are the result of a careful and regular search organized by Hubble, Baade and Zwicky, in the course of which the most important clusters of nebulæ were photographed as often as possible and tens of thousands of nebular images carefully searched for new stars (see *Publ. Astro. Soc., Pacific*, 49, 290; 1937).

Zwicky's recent super-novæ are of special interest because of their enormous absolute brightness, namely, −16, which makes them the most luminous stars known.

The first of these new stars, "Nova 144.1937 Canum Venaticorum", was found with the 18-in. Schmidt telescope in the faint nebulæ *I.C.* 4182 on August 31, when it had already reached the magnitude 8·5. It then faded rather rapidly; M. Beyer-Hamburg (*Astro. Nach.* No. 6307) recorded it on September 2 as 8·85 m., and by September 6 it had decreased to 9·8 m. In this period several spectra have been obtained by K. Walter and W. Strohmeier, of the Astrophysical Observatory at Potsdam (*Astro. Nach.*, No. 6308). The plates show on a rather strong continuous background some very wide emission bands, the whole spectrum having an appearance similar to that of a Wolf Rayet star of early *O*-type, characterized by bands at λ 4680 and λ 5411, He II, λ 5007, [O III], and the Balmer lines. Discussing spectra obtained at the Lick Observatory, D. M. Popper (*Publ. Astro. Soc. Pacific*, 49, 282; 1937) expresses the half-widths of the most distinct bands in km./sec. and finds a velocity of expansion of the star of about 4500 km./sec.

The other super-nova was discovered on September 10 in the east end of the nebula *NGC* 1003. Plates taken at the Hamburg-Bergedorf Observatory on September 6 and September 8 by A. Wachmann showed the star increasing from 13·6 m. to 13·3 m. (*Astro. Nach.*, No. 6310). On September 19, W. Strohmeier succeeded in obtaining an objective prism

spectrum with the Potsdam 30-cm. reflector. This plate reveals strong emissions of He II at λ 5411 and of the nebular lines of [O III] at λ 5000, the width being about 200 A. The continuous spectrum resembles that of a *B*-type star. Neutral helium at λ 4471, 4388, 4144, 4026 appears in absorption. The Balmer lines are present as faint emissions, perhaps with violet absorption companions.

The photographic light curve of this super-nova, "145.1937 Persei", has recently been discussed by A. Beer and C. C. L. Gregory before the Royal Astronomical Society. This paper was based on a number of plates secured with the 24-in. Wilson reflector of the University of London Observatory at Mill Hill. The results show that the brightness of this nova was also fading rapidly. From 13·3 m. on September 20 it decreased to 13·8 m. on September 26, to 14·6 m. on October 3–4, and to 15·4 m. on October 9–10. Soon afterwards the star had become too faint for these observations. A high positive colour index is indicated, the visual brightness on October 12 being greater by 1·7 m. than the photographic value. No reports from the large American observatories are yet available, and nothing is known up to now about the doubtlessly very interesting spectroscopic results obtained there.

Development of Co-axial Cables for Television

ONE of the results of the modern developments in television technique has been the production on a commercial scale of cables capable of transmitting, with reasonable efficiency, alternating electric currents at frequencies up to one or two megacycles per second. These cables, which are of the concentric or co-axial type, are employed in the first place for conveying from the studio or outdoor scene to the television transmitter, the modulation frequency currents of the scene being televised. Such a cable is, for example, employed by the B.B.C. to connect the Alexandra Palace station to Broadcasting House and other important places in central London. But the scope of the application is now being extended to the use of the cables for the interconnexion of television transmitting stations separated by distances of the order of 100 miles. When the distance covered is of this order, the use of the cable is by no means limited to television, since the frequency band available provides a large number of ordinary telephone channels along the cable, thereby considerably augmenting the normal land-line trunk-connexion facilities. By a suitable arrangement of the relative frequencies, these telephone channels can be operated simultaneously with the transmission of the television signals, and the value of the cable is thus considerably enhanced. At the present time, a high-frequency co-axial cable is being installed by the Post Office between London and Birmingham, and the results of its operation will be awaited with interest.

Although Great Britain has been the pioneer country in operating a public television broadcasting service, the development and installation of these cables have been proceeding elsewhere, notably in Germany and the United States. The *Wireless World* of December 30 contains a note on the work of the German Post Office on a scheme for the linking-up of Berlin with other important towns. The cables in contemplation or actually undergoing installation will provide interconnexion between the television stations; the Post Office will further provide television-telephone facilities and in addition, arrangements have been made for sending as many as two hundred telephone conversations along the new cables in the frequency band not required by the television currents. For the purpose of transmitting television pictures on a basis of 441-line definition and interlaced frames at 25 per second, it will be necessary to instal amplifiers or repeaters at intervals of 10–12 miles along the cable. These repeater stations will be entirely unattended and will be supplied with power-frequency alternating current passed along the cable. Three types of cable made by different firms are being employed, and it is anticipated that the installations will be completed during the current year.

An interesting demonstration of the possibilities of these co-axial cables was provided last November by the transmission of a sound-picture film between New York and Philadelphia, a distance of ninety miles. This matter was briefly referred to in NATURE of December 4 (p. 962), and further details of the experiment have now been supplied by the Bell Telephone Laboratories. The cable in this case consists of two co-axial conductor units, each of which is formed of a flexible copper tube and a single concentric wire insulated at intervals with ebonite disks. Along the route are situated unattended installations of special amplifying equipment which receive their power supply over the two inner conductors. Each of the co-axial conductors with its associated one-way amplifiers is capable of transmitting simultaneously the currents from 240 telephone transmitters. Thus, using the two units of the cable for transmission in opposite directions, the system provides for 240 simultaneous conversations. In the present arrangement, the transmitters are formed into twenty groups of twelve, each transmitter being limited to a frequency band of four kilocycles per second. For the transmission of vision or picture signals, practically the entire frequency band of the cable—about one million cycles per second—is utilized.

In the demonstration to which reference was made above, a cinematograph film moving uniformly past a gate where it was scanned by a rotating disk system at a rate corresponding to 240 lines and 24 frames per second was used to provide a picture. The light passing through the film entered an electron multiplier, and the resulting current contained component frequencies between zero and about 800 kc./sec. For transmission along the cable, the frequency of this signal current was raised by modulation about 100 kc./sec. in order to avoid the portion of the range where transmission would be unsatisfactory and amplification difficult. In passing along the cable, the lowest frequencies fall behind the highest by a time amounting to some twenty microseconds. Delay equalizers were therefore developed to secure equal transmission times for all frequencies

to within a quarter micro-second. At the receiving end a cathode ray tube was employed to produce a picture about eight inches square, and the demonstration provided satisfactory and clear reproduction of the scenes portrayed on the film at the sending end.

At the conclusion of the demonstration Dr. F. B. Jewett, president of the Bell Telephone Laboratories, stated that the experimental development was proceeding with the view of extending the operating frequency range of the cables and associated apparatus to at least two megacycles per second. This would provide a system capable of accommodating the maximum number of telephone channels which it is economical to handle on such a cable, or the widest band of frequencies which the best television scanning and reproducing apparatus may require.

Fuel Research in Great Britain

THE annual report of the Fuel Research Board[1] is always an interesting document because it covers so wide a range of topics that the reader can gain a fair conspectus of the problems engaging the attention of fuel technologists at the moment. The Coal Survey of Great Britain is probably, taking the long view, its most important task, and steady progress is recorded. With time, the scope of its activities increases as increased refinement in fuel processes makes greater demands on the supplies of raw fuel. The demand for cleaned, closely sized fuel grows at the expense of that for large lumps, and this creates many problems. The problem of breaking coal, removing dust and fine coal, clarifying wash water grow in importance. In Yorkshire, efforts are being made to reduce the number of standard sizes, which are bewildering in their number and names. The dust-proofing of coal by spraying it with suitable oil or other liquid to prevent the raising of dust when disturbed is another problem receiving study.

The investigation of the production of oil from coal continues. The staff at Greenwich has studied the process of carbonization at low temperatures from the outset and evolved a design of vertical retort for the purpose. It is now reported that a setting of these retorts has been in operation at the South Yorkshire Chemical Works Ltd., near Rotherham, during the period under review and has given entire satisfaction.

A more comprehensive account of the Fuel Research Board's work on domestic fuels is found in Technical Paper No. 46, describing the results of Mr. J. S. Hales' observations on the use of coke in open fires[2]. Although it covers some ground previously traversed by others, only good can follow repeated assertion of experimentally ascertained facts so imperfectly known or understood. Although fire has been used by man through the ages, until recently no quantitative answers could be given to some of the simplest questions. This is exemplified in Mr. Hales' report, for he deemed it necessary to show by experiment that the rate of combustion of an open fire is not changed by opening or closing a canopy, if fitted.

Great ignorance prevails as to the relative merits of coals and cokes so that the view—encouraged by some coal merchants—is common that coke is a debased fuel fit only for the indigent. In this connexion, the general conclusion of this report is important, namely, that "'combustible' coke may be superior to normal household coal from the point of view of freedom from smoke, easy ignition and rate of initial combustion, but that the control of the rate of radiation of heat can be more easily achieved with coal". It ought to be pointed out that a measure of control is possible, but the consumer needs educating in the technique of using carbonized fuels.

The basis of test used is the measurement of radiation in one direction emitted by a fixed *volume* of fuel in a single charge. This method gives useful information capable of interpretation by a discerning reader. Fuel, however, is bought by *weight*, and the undiscerning reader may get a wrong idea of the comparative cost of the unit of radiated heat, from the statement that the maximum radiation from a normal household coal may exceed by 30 per cent that from a coke. This apparently relates to equal volumes of fuel and the fact is obscured that the rate of consumption of the coal probably exceeds that of coke by 50 per cent.

The third report of the Oil from Coal Committee issued by the Scottish Development Council merits attention not merely for its contents, but also as an example of local initiative[3]. Areas hit by depression may have been richly endowed with natural resources. Those who have exploited these resources have often been content to take out great wealth without 'ploughing in' sufficient to develop subsidiary industries. Thus a decline in the main industry leaves the area economically stranded. The efforts of the Scottish Development Council set a good example of the local self-help by scientific study of the possibility of grafting new industry upon old stock. The report deals with experiments on the low temperature carbonization of Scottish coal, but the conclusions are not too hopeful as to the economic aspects.

The Duke of Montrose criticizes the manner in which the Committee has approached the problem of marketing, and there is force in his criticism. No one familiar with the matter will expect the use of raw coal to be easily displaced and the consumer must be educated to understand the conclusions of the Technical Paper No. 46 (v.s.), namely, that cokes have advantages as well as disadvantages. The technique of using them must be taught and the organization of sales and distribution will require effort, otherwise the best laid scheme may fail. Thus in one town municipal houses were fitted with grates suitable for burning coke, but no organization was provided for the regular distribution of suitable fuel in small quantities; the tenants consequently burn coal delivered at the door. H. J. H.

[1] Department of Scientific and Industrial Research. Report of the Fuel Research Board for the year ended March 31, 1937; with Report of the Director of Fuel Research. Pp. ix+213+5 plates. (London: H.M. Stationery Office, 1937.) 3s. 6d. net.

[2] Department of Scientific and Industrial Research: Fuel Research Technical Paper No. 46: "The Use of Coke in Open Domestic Grates". By J. S. Hales. Pp. vi+50. (London: H.M. Stationery Office, 1937.) 1s. net.

[3] Scottish Development Council. Economic Series No. 14: Scottish Industry—Third Report of the "Oil from Coal" Committee. (Revised.) Pp. 46. (Glasgow: Scottish Development Council, 1937.) 6d. net.

Science News a Century Ago

Progress of Statistical Studies

THE anniversary meeting of the Statistical Society was held on March 15, 1838, the Earl Fitzwilliam being elected president. In the report of the Council read at the meeting it was said: "The direct and incidental use which, at present, is made of statistical documents in scientific and philosophical writings on the most important moral and political questions, and the now frequent insertion of statistical notices in the publications of the day, may be adduced as indicating the prevalence of a sense of the indispensable necessity of continually adverting to the tabulated numerical results of systematic inquiries. It is, indeed, truly said, that the spirit of the present age has an evident tendency to confront the figures of speech with the figures of arithmetic, since it is impossible not to observe a growing distrust of mere hypothetical theory and *à priori* assumption. But a more decisive proof of the just estimate which is formed of the value, and of the deep interest which is felt for the result of statistical researches is presented in the continual formation of new societies." The report then went on to refer to statistical organizations in Liverpool, Ulster, New York, Turin, Calcutta, Manchester, Bristol and York.

Nathaniel Bowditch (1773-1838)

ON March 16, 1838, Nathaniel Bowditch, the American mathematician, died at Boston at the age of sixty-four years. He was born in Salem, Mass., on May 26, 1773, of poor parents. At the age of twelve years he was placed in a ship chandler's shop, but by his own exertions became a good mathematician and learnt Latin in order to read Newton's "Principia" in the original. Leaving the shop when twenty-one years of age, he went to sea as a clerk and rose to be a master. In 1800 he published his "Practical Navigator", and quitting the sea in 1803 became president of an insurance company in Salem. Twenty years later he was made actuary to the Hospital Life Insurance Company, Boston, then the largest institution of its kind in the United States. He was offered chairs of mathematics at Harvard, in the University of Virginia and in the Military Academy at West Point, but declined them. For several years he was president of the American Academy of Arts and Sciences and contributed many papers to its transactions. The great work of his life was the translation of, and his commentary on, Laplace's "Mécanique Céleste" in four volumes of over a thousand pages each. He commenced this work in 1815 and was correcting the proofs of the last pages of the fourth volume when he died. The work met with a flattering reception both in America and Europe. He was elected a member of many societies, including the Royal Society, and the Royal Society of Edinburgh, and for twelve years was a fellow of Harvard College.

Parrot's Observations at North Cape

IN the *Athenæum* of March 17, 1838, it is stated that Prof. Parrot, well known for his travels to the Caspian Sea and Caucasus and more recently for his ascent of Mount Ararat, made a journey in the course of last summer to North Cape, for the purpose of making astronomical and magnetical observations, and of noting the oscillations of the pendulum at the most northern point of the European continent. Leaving Dorpat on July 10 he reached Tornea on July 23, proceeded 380 miles up the Rivers Tornea and Muonio and reached the source of the latter close to the borders of Sweden, Norway and Russia. Leaving his boat, his instruments were carried by eight Finlanders to the inlet Lyngen Fiord, where he embarked in a small boat for a journey of 200 miles to North Cape, which he doubled on August 25. His observations were made under favourable circumstances. He returned to Dorpat in December with, it is presumed, a rich harvest of philosophical materials.

Anthracite Coal for Iron Smelting

THE *Mechanics' Magazine* of March 17, 1838, quoting from the *Cambrian*, said: "On Friday the 23rd ult., a public dinner was given at Swansea to Mr. Crane, the inventor and patentee of the application of anthracite coal to the smelting of iron ores. Mr. Crane was invited by public requisition from upwards of one hundred mineral proprietors and others, interested in the successful results of his valuable discovery. . . . The practical application of Mr. Crane's discovery has now been fully tested for upwards of twelve months at the Yniscedwin Iron Works. . . . His success will, we trust, stimulate others to the application of this valuable fuel to other branches of trade. Already we hear that the experiments are now in progress, and we have every reason to believe that ere long the economical application of this coal for the generation of steam in marine engines will be proved beyond a doubt."

Societies and Academies

London

Royal Society (*Proc.*, A, **164**, 307–446; February 4).

HAROLD JEFFREYS: Significance tests for continuous departures from suggested distributions of chance.

O. W. RICHARDSON: New bands ending on the $1s\sigma 2p\sigma\,^1\Sigma_u$ state of H_2.

ROSA M. MORRIS: Two-dimensional hydrodynamical theory of moving aerofoils (2).

T. H. GOODWIN and R. HARDY: Crystal structure of pentaerythritol tetracetate.

C. A. COULSON: Electronic structure of some polyenes and aromatic molecules. (4) The nature of the links of certain free radicals.

G. W. WHELAND: Electronic structure of some polyenes and aromatic molecules. (5) A comparison of molecular orbital and valence bond methods.

W. G. PENNEY and G. J. KYNCH: Electronic structure of some polyenes and aromatic molecules. (6) Phenylethylene, stilbene, tolane and the phenylmethyl radical.

H. M. CUNDY: Rotational energy-levels of a diatomic molecule in a tetrahedral field.

J. MONTEATH ROBERTSON and I. WOODWARD: X-ray analysis of the dibenzyl series. (5) Tolane and the triple bond.

Proc., A, **164**, 447–603; February 18.

A. N. BLACK and R. V. SOUTHWELL: Relaxation methods applied to engineering problems. (2) Basic theory, with applications to surveying and to electrical networks, and an extension to gyrostatic systems.

E. V. APPLETON and J. H. PIDDINGTON: Reflection coefficients of ionospheric regions.

G. I. TAYLOR: Spectrum of turbulence.

C. J. B. CLEWS and F. SCHOSZBERGER: Structure of stretched rubber.

F. J. WILKINS: (1) Statistical mechanics of the adsorption of gases at solid surfaces. (2) Adsorption of argon, nitrogen and oxygen on smooth platinum foil at low temperatures and pressures.

A. ELLIOTT and W. H. B. CAMERON: Emission band spectrum of chlorine (Cl_2^+). (2).

L. HOWARTH: On the solution of the laminar boundary layer equations.

DOROTHY CROWFOOT: The crystal structure of insulin. (1) The investigation of air-dried insulin crystals.

Geneva

Society of Physics and Natural History, December 2.

RICHARD EXTERMANN and JEAN WEIGLE: Bragg reflection on a medium disturbed by ultra-sounds. The theory of the reflection of light on a face perpendicular to the direction in which a medium is periodic is established. The case is analogous to that of Bragg reflection of X-rays on a crystal.

LÉON SCHAMES: Interstellar matter as the eventual cause of the displacement of the spectrum of nebulæ towards the red. Starting from the properties of interstellar matter a characteristic distance can be calculated. It follows that the empirical displacement in this distance is equal to the wave-length of Compton. This suggests that the light produces on the small particles composing interstellar matter, besides the classical Mie effect, a quantum effect which would then be the cause of the displacement.

December 16.

GEORGES TIERCY: (1) Direct calculation of the velocity of the wind as a function of the height. The purpose of this note is to indicate some hypotheses of work which can be admitted for certain coefficients and to write the differential equations which follow. An approximate solution is then established which expresses the wind velocity as a function of the altitude. The constants of integration will take values suitable for each atmospheric layer. (2) Variation of the pressure gradient with altitude. Starting with the well-known equality which connects the pressure with the absolute temperature at a height, and adopting for the variation of T the law $T = T_0.e^{-\frac{z}{m.T_0}}$, it is shown that the variation of the pressure gradient can be represented by the simple law $G = G_0.e^{\mu z}$, where μ remains small.

EMILE BRINER, C. EL-DJABRI and HENRI PAILLARD: The ozonation of some hydrocarbons (hexane, heptane and various octanes). As in the cases studied before, the presence of ozone leads, in the oxidation, to large proportions of oxygen being involved. These proportions, however, are much smaller for one of the *iso*-octanes (2-2-4 trimethylpentane), well known for its high anti-detonant power.

PAUL WENGER, CHEVEL CIMERMAN and ALICE CORBAZ: The micro-estimation of cobalt by means of anthranilic acid. I. (1) The Pregl technique. (2) The Emich technique. The authors have established a gravimetric micromethod for the estimation of cobalt by two microchemical techniques, those of Pregl and Emich. II. The influence of foreign salts. The authors have studied the influence of sodium acetate, sodium chloride and ammonium chloride on the micro-determination of cobalt with anthranilic acid.

CHEVEL CIMERMAN and PAUL WENGER: Micro-separations of zinc with ortho-oxyquinoline. The authors have established a working method for micro-separations with ortho-oxyquinoline in the presence of calcium, strontium, barium, aluminium, chromium and lead.

Rome

National Academy of the Lincei (*Atti*, 26, 3–53; 1937).

N. SPAMPINATO: Functions of one variable in one of the four commutative complex algebras of the third order.

A. COLACEVICH: Orbital elements of ν Octantis.

S. VARDABASSO: Contribution to the knowledge of the recent volcanism in Sardinia.

C. FINZI and M. COLONNA: Chemical constitution and sweet taste.

C. LAURO: Calcite from the hill of the Madonna del Carmine in Dorgali (Sardinia).

V. CAPRARO and M. FORTUNATO: Contribution to the study of the antineuritic factor (B_1) on the testicle.

M. FEDELE: Contractability and neurogenic and miogenic excitation in the Ascidiacea.

A. SPIRITO: Studies in embryology. Different behaviour towards anærobiosis and normal absorption of oxygen in the various forms of Amphibia.

E. PLATANIA: The origin of the peritrophic membrane of the intestine of *Reticulitermes lucifugus* Rossi.

A. BAGLIONI: Antineuritic vitamin B_1 content of Italian grains.

V. CAPRARO: Thyroidisation and experimental beriberi in the pigeon.

Tokyo

Imperial Academy (*Proc.*, 13, No. 10, December 1937).

TATSUO KAWATA: A theorem concerning the Fourier series of a quadratically summable function.

SHIN-ICHI and TATSUO KAWATA: Notes on Fourier series. (1) Riemann sum. (2) Convergence factor.

MASAO SUGAWARA: Transformation of a theta-function by Siegel's modular substitutions.

HIDETAKA TERASAKA: Theory of topological combinations.

HITOSHI HOMBU: (1) Projective parameter of generalized 'paths'. (2) Projective theory of 'paths' $x^{(3)i} + A^i_{jk}x^{(1)j}x^{(1)k} + B^i = 0$.

HISAKATSU YABE: Palæogene stratigraphy of Russian Saghalin (2).

HISAKATSU YABE and TASHIO SUGIYAMA: (1) Preliminary report on the fossiliferous Gotlandian and Devonian deposits newly discovered in the Kitakami Mountain land. (2) Some reef-building corals of a raised coral reef of Mindanao, Philippine Islands. Fourteen species belonging to eleven genera of corals are described, together with four specifically indeterminable forms. (3) Two new species of reef-building corals from Yoron-zima and Amami-Ô-sima. One species belongs to the genus *Favites* and the other to *Psammocora*.

TORANOSUKE SUGIURA: A list of chromosome numbers in angiospermous plants (4). The meiotic numbers of 37 species belonging to 12 families have been determined.

Forthcoming Events

[*Meeting marked with an asterisk is open to the public.*]

Monday, March 14

ROYAL GEOGRAPHICAL SOCIETY, at 5.—Discussion on the Air Almanac to be opened by Dr. H. Spencer Jones.

Tuesday, March 15

UNIVERSITY OF CAMBRIDGE (Cavendish Laboratory), at 3.—Prof. W. Pauli: "Contributions to the Theory of Field Quantization" (succeeding lectures on March 16 and 18).

UNIVERSITY COLLEGE, LONDON, at 5.—Prof. A. P. H. A. de Kleijn: "Some Remarks on Vestibular Physiology".*

Wednesday, March 16

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—F. Entwistle: "Atlantic Flight and its Bearing on Meteorology" (Symons Memorial Lecture).

SOCIETY FOR THE STUDY OF ALCHEMY AND EARLY CHEMISTRY, at 8.—Prof. R. Campbell Thompson: "Assyrian Chemistry of the Seventh Century B.C."

Thursday, March 17

CHEMICAL SOCIETY AND PHYSICAL SOCIETY (joint meeting at Burlington House, Piccadilly, W.1), at 8.—Discussion on "Electron Diffraction and Surface Structure", to be opened by Prof. G. J. Finch.

Friday, March 18

ROYAL INSTITUTION, at 9.—Sir William Bragg, P.R.S.: "Ice".

Appointments Vacant

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:

TECHNICAL OFFICER (male) in the Meteorological Office—The Secretary (S.2.A.), Air Ministry, Adastral House, Kingsway, London, W.C.2 (March 12).

JUNIOR ASSISTANT BACTERIOLOGIST in the Department of Pathology, Postgraduate Medical School, Ducane Road, London, W.12—The Dean (March 14).

LECTURER IN PSYCHOLOGY in the Brighton Municipal Training College for Women—The Education Officer, 54 Old Steine, Brighton (March 18).

ASSISTANT (grade II—engineering or physics) at the Air Ministry Headquarters—The Secretary, Air Ministry (S.2.D.), Room S.205, Kingsway, London, W.C.2 (March 18).

TEACHER OF CHEMISTRY in the Northern Polytechnic, Holloway, N.7—The Clerk (March 23).

ASSISTANT (lady) to the Director of Research, Wool Industries Research Association, Torridon, Leeds—The Secretary (March 24).

ASSISTANT CHEMIST in the London Shellac Research Bureau—The High Commissioner for India, General Department, India House, Aldwych, London, W.C.2 (March 25).

ASSISTANT ADMINISTRATIVE OFFICER in the Research Department, Woolwich, S.E.18—The Chief Superintendent (March 25).

LECTURER IN ELECTRICAL AND GENERAL ENGINEERING in the Faraday House Engineering College, Southampton Row, W.C.1—The Principal (March 26).

THREE UNIVERSITY DEMONSTRATORS IN ANATOMY in the University of Cambridge—Dr. F. J. W. Roughton, Department of Physiology, Cambridge (March 31).

INVESTIGATOR (welding) in the British Non-Ferrous Metals Research Association, Regnart Buildings, Euston Street, London, N.W.1—The Secretary (March 31).

SECRETARY of the London School of Economics, Houghton Street, Aldwych, W.C.2—The Director (March 31).

RESEARCH ASSISTANT (computational work) in the Mathematics Department, Imperial College of Science and Technology, South Kensington, S.W.7—The Secretary (April 21).

LECTURER IN PHYSIOLOGY in the Queen's University, Belfast—The Secretary.

PROFESSOR OF ENGINEERING in the Queen's University, Belfast—The Secretary.

ASSISTANT CIVIL ENGINEERS in H.M. Office of Works, Storey's Gate, S.W.1—The Chief Architect, Room 65 A/3.

ASSISTANT (grade II—engineering) at the Royal Aircraft Establishment, South Farnborough, Hants—The Chief Superintendent (March 18—quote Ref. No. 361B).

Reports and other Publications

Great Britain and Ireland

Proceedings of the Royal Society of Edinburgh, Session 1937–1938. Vol. 58, Part 1, No. 1: Induction Proofs of the Relations between certain Asymptotic Expansions and Corresponding Generalised Hypergeometric Series. By Prof. T. M. MacRobert. Pp. 13. 1s. Vol. 58, Part 1, Nos. 2, 3 and 4: Quantitative Evolution. iv. Deductions from the BAT Curve; v. The Free and Apparent Dp-Ages of Composite; vi. Further Deductions from the BAT Curve. By Prof. James Small. Pp. 14–54. 3s. 6d. (Edinburgh: Robert Grant and Son, Ltd.; London: Williams and Norgate, Ltd.) [72

University of Leeds. Thirty-third Report, 1936–37. Pp. 179. Publications and Abstracts of Theses by Members of the University during Session 1936–37. Pp. 27. (Leeds: The University.) [92

University College, Nottingham. An Outline of the Scope of University Education provided; a Statement as to available Scholarships, Exhibitions and Studentships; Notes on the Careers open to Students. Pp. 36+8 plates. (Nottingham: University College.) [92

Manchester Museum: University of Manchester. Museum Publication 113: Report for the Year 1936–37. Pp. 32. 6d. Museum Publication 114 (Notes from the Manchester Museum, No. 39): Four Greek Vases in the Manchester Museum. By Prof. T. B. L. Webster. Pp. 9–20+5 plates. 6d. (Manchester: Manchester Museum.) [122

The Girlhood of Mrs. Ramsay MacDonald. By Isabella M. Hobson. Pp. 16. (London: *Middlesex County Times* Printing and Publishing Co., Ltd., Ealing.) 6d. [122

Other Countries

Imperial College of Tropical Agriculture: Low Temperature Research Station. Memoir No. 7: Tropical Fruits and Vegetables; an Account of their Storage and Transport. By C. W. Wardlaw. Pp. xii+224. (Trinidad: Imperial College of Tropical Agriculture.) 4s. [72

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 10: Indian Grazing Conditions and the Mineral Contents of some Indian Fodders. By Dr. P. E. Lander. Pp. 71. (Delhi: Manager of Publications.) 3.14 rupees; 6s. 9d. [72

U.S. Department of Agriculture. Technical Bulletin No. 584: Chemical and Physical Studies of certain Hawaiian Soil Profiles. By George J. Hough and Horace G. Byers. Pp. 27. (Washington, D.C.: Government Printing Office.) 10 cents. [72

Journal of the Indian Institute of Science. Vol. 20A, Parts 3, 4, 5 and 6: Equilibrium in Electrodeless Discharge. Part i. The Disappearance of Hydrogen in Electrodeless Discharge; Part ii. Electrodeless Discharge through Water Vapour and Silane; Part iii. Electrodeless Discharge through Oxygen; Part iv. Electrodeless Discharge through Carbon Dioxide. By N. B. Bhatt and S. K. K. Jatkar. Pp. 25–48. 1.12 rupees. Vol. 20A, Part 7: Proteins of Indian Vegetables—Drumstick (*Moringa pterygosperma* or *Guilandina* or *Hyperanthera*). By Y. V. S. Rau and V. Ranganathan. Pp. 49–54. 10 annas. Vol. 20A, Part 8: Reactions of Chromates at High Temperatures. Part iii. The Decomposition of Calcium Chromate. By V. T. Athavale and S. K. K. Jatkar. Pp. 55–66. 1.4 rupees. Vol. 20A, Part 9: On Chemical Methods of determining Phosphorus Availability in Soils. By V. Sadasivan and A. Sreenivasan. Pp. 67–81. 1.2 rupees. Vol. 20A, Part 10: The Rôle of Pepsin in the *in vitro* Digestion of Proteins. By V. Ranganathan and B. N. Sastri. Pp. 83–86. 8 annas. Vol. 20A, Part 11: The System Sulphuric Acid—Ethers. Part i. System Sulphuric Acid—Methyl Ether. By S. K. Kulkarni Jatkar and N. G. Gajendragad. Pp. 87–93. 12 annas. (Bangalore: Indian Institute of Science.) [72

Union of South Africa: Department of Commerce and Industries: Fisheries and Marine Biological Survey Division. Report No. 14 for the Year ended December 1936. By the Director of Fisheries. Pp. 83+4 plates. (Pretoria: Government Printer.) [82

Annual Report of the Public Health Commissioner with the Government of India for 1935. Vol. 1, with Appendices. Pp. viii+276. (Delhi: Manager of Publications.) 2 rupees; 3s. 6d. [102

Smithsonian Institution: United States National Museum. Report on the Progress and Condition of the United States National Museum for the Year ending June 30, 1937. Pp. iii+120. (Washington, D.C.: Government Printing Office.) 15 cents. [102

Ministry of Finance, Egypt: Survey of Egypt. Geology of Egypt. Vol. 2: The Fundamental Pre-Cambrian Rocks of Egypt and the Sudan; their Distribution, Age and Character. Part 3: The Minerals of Economic Value associated with the Intrusive Pre-Cambrian Igneous Rocks and Ancient Sediments, and Methods suggested for the Dating of Historical and Geological Times. By Dr. W. F. Hume. Pp. xxxv+689–990+75+plates 150–196. (Cairo: Government Press.) P.T. 250. [102

U.S. Department of the Interior: Office of Education. Bulletin, 1937, No. 24: Continuity of College Attendance. By Fred J. Kelly. Pp. iii+24. 5 cents. Pamphlet No. 82: Physical Education in Institutions of Higher Education. By Dr. James Frederick Rogers. Pp. v+52. 10 cents. (Washington, D.C.: Government Printing Office.) [112

U.S. Department of Agriculture. Circular No. 460: Silver Fox Pelt Prices as affected by Time of Pelting, Sex and Age. By Chas. E. Kellogg. Pp. 28. (Washington, D.C.: Government Printing Office.) 10 cents. [112

U.S. Department of Commerce: National Bureau of Standards. Circular C418: Architectural Acoustics. By Paul R. Heyl and V. L. Chrisler. Pp. ii+11. (Washington, D.C.: Government Printing Office.) 5 cents. [112

University of Illinois: Engineering Experiment Station. Bulletin 298: Resistance to Heat Checking of Chilled Iron Car Wheels, and Strains developed under Long-continued Applications of Brake Shoes. By Prof. Edward C. Schmidt and Prof. Herman J. Schrader. Pp. 50. (Urbana, Ill.: University of Illinois.) 55 cents. [112

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